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BUTTERFLY (INSECTA: LEPIDOPTERA) SPECIES DIVERSITY IN OFK ESTATE, JABALPUR, MADHYA PRADESH, CENTRAL INDIA

Shivam Dubey*, Shiv Ji Malviya and Hemlata Pant

*Govt. Science College, Jabalpur, Madhya Pradesh, India

**Department of Zoology, H.N.B. Degree College, Naini, Prayagraj, (U.P.), India

***Department of Zoology, CMP PG College, Prayagraj-211002, (U.P.), India

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ABSTRACT

The present data is grounded on the opportunistic surveys conducted in the OFK Estate, Jabalpur (M.P.). The OFK, better known as the Ordnance Factory Khamaria is situated in the eastern part of the Jabalpur district. The sites under surveys included several residential colonies, wetlands, agricultural fields as well as forest area. The area is also surrounded by villages. Ordnance Factory Khamaria is world-famous for the production of explosives which are supplied to the Indian Army and other paramilitary forces, hence, the areas which were being studied here are restricted in terms of human interferences. The area holds the promise to provide a niche to a wide range of flora and fauna due to the presence of a dense forest cover. Various species of mammals, birds, reptiles, and amphibians can be spotted here. In the present study, butterfly diversity includes 37 species belonging to 5 families.

Keywords **-** *OFK, khamaria, jabalpur, biodiversity, butterfly.*

INTRODUCTION

Among insects, butterflies are very sensitive towards any change in the surrounding environmental conditions and within the forest structure as they're closely associated with the flora present in their vicinity (Pollard 1991). Butterflies are usually thought to be one of the simplest taxonomically studied assemblages of insects. There are pieces of literature suggesting they had been studied consistently since the eighteenth-century and concerning 18,000 species are documented worldwide (Martinez *et al*., 2003). This figure isn't constant owing to the continual addition of the latest butterflies and conjointly because of current disagreements between taxonomists over the standing of the many species. According to Robbins and Oplar (1997), worldwide there are over 28,000 species of butterflies; with approximately 80% of them are found in tropical regions. It should be noted that Antarctica is the only continent where no butterflies are found. Rhopalocera constitute one of the extremely specialized insect orders, including scaly winged insects of the holometabolic endopterygote type. Butterfly shows total metamorphosis and passes through varied stages like egg, larva, pupa, and adult stage.

The Indian-subcontinent with various pieces of land, climate, and vegetation hosts concerning 1,504 species of butterflies (Tiple, 2011) of that the peninsular region hosts 351, and the

Western Ghats 336 species. Butterflies alters the sustenance of any habitat through their role in pollinating activities and serves as a crucial part of any food-chain. Being potential pollinating agents of their nectar plants moreover as indicators of the health and quality of their host plants (Tiple *et al*., 2006) and therefore the entire ecosystem as a whole, exploration of butterfly fauna so becomes vital in characteristic and identifying protective potential habitats under threat. Butterflies also are smart indicators of any environmental changes as they're sensitive to environmental degradation and climate changes (Kunte, 2000). In central India, the butterfly species diversity was described earlier by Forsayeth (1884), Swinhoe (1886), Betham (1890, 1891), Witt (1909), and D'Abreu (1931) who documented 177 butterfly species from Madhya Pradesh and Vidarbha region (previously known as the Central Province). Consequent monumental works and fauna volumes by Evans (1932), Talbot (1939, 1947), Wynter-Blyth (1957) describes many species from Madhya Pradesh and Chhattisgarh. In current trends, several species have been undertaken on district levels as well as in many protected areas of Central India. Few notable contributions being given by Singh (1977), Gupta and Shukla (1987), Chaudhury (1995), Chandra *et al*., (2000 a, b; 2002), Singh & Chandra (2002), Siddiqui & Singh (2004), and Chandra (2006) and Chandra *et al,* (2021).

In 2007, Chandra *et al*., identified 174 species of butterflies from 100 genera underneath eight families from Madhya Pradesh and Chhattisgarh. Singh and Koshta, 2008 described thirty-nine species of butterflies from Jabalpur District, Madhya Pradesh. The Narmada valley naturally creates a wonderful habitat for several faunal species like insects, reptiles, birds, and mammals (Tiple *et al*., 2010). Recently, Tiple (2012) recorded sixty-two species of butterflies from forty-seven genera and 5 families from the TFRI Campus, Jabalpur. Most recently, Dubey *et al*., (2020) reported 37 species of butterflies form CMM campus and Flora *et al*., (2020), identified 112 species of butterflies belonging to 71 genera, under six families.

The Ordnance Factory Khamaria is one of the premier Défense establishment situated in Jabalpur district of Madhya Pradesh. The factory is famous for the production of many types of explosives which in turn is supplied to the Indian Army as well as other Paramilitary Forces. The whole estate covers an area of approximately 1200 hectares, is divided into two major parts - Westland and Eastland. The majority of the estate is covered with forest or shrubby vegetation. In between, there occurs a few plains as well as wetlands. During the monsoons, many small temporary water bodies are also formed which attracts a number of faunal species especially many migratory birds to the area. The estate area has many residential buildings, a hospital, and a degree in college.

MATERIALS AND METHODS

The findings bestowed within the article are supported by sampling through repeated surveys and photograph documentation on a biweekly basis from 2016 to 2019 in and around the OFK Estate area. The surveys are generally conducted between 0800hr to 1100hr, which may be a peak time for butterfly activity. Identification of the butterflies was primarily created directly within the field. In important condition, specimens were collected solely with hand-held aerial sweep nets and later on discharged while not hurt. Every specimen was placed in plastic bottles and carried to the laboratory for additional identification with the assistance of field guides (Wynter-Blyth 1957; Kunte 2000). All scientific names followed within the gift study are in accordance with Varshney (1983).

Table - 1 : Butterfly diversity in OFK Estate, Jabalpur

S. No.	Family	Common Name	Scientific Name	Authority
	Papilionidae			
1		Spot Swordtail	*Graphiumnomius*	(Esper)
2		Common Rose	*Pachlioptaaristolochiae*	(Fabricius)
3		Lime	*Papilio demoleus*	Linnaeus
4		Common Mormon	*Papilio polytes*	Linnaeus
	Pieridae			
5		Lemon Emigrant	*Catopsiliapomona*	(Fabricius)
6		Mottled Emigrant	*Catopsiliapyranthe*	(Linnaeus)
7		Common Jezebel	*Delias eucharis*	(Linnaeus)
8		Common Grass Yellow	*Euremahecabe*	(Linnaeus)
9		Spotless Grass Yellow	*Euremalaeta*	(Boisduval)
	Nymphalidae			
10		Tawny Coster	*Acraea violae*	(Fabricius)
11		Angled Castor	*Ariadne ariadne*	(Linnaeus)
12		Black Rajah	*Charaxes solon*	(Fabricius)
13		Painted Lady	*Cynthia cardui*	(Linnaeus)
14		Plain Tiger	*Danaus chrysippus*	(Linnaeus)
15		Striped Tiger	*Danaus genutia*	(Cramer)
16		Baronet	*Euthalia nais*	(Forster)
17		Great Eggfly	*Hypolimnasbolina*	(Linnaeus)
18		Danaid Eggfly	*Hypolimnasmisippus*	(Linnaeus)
19		Peacock Pansy	*Junonia almanac*	(Linnaeus)
20		Chocolate Pansy	*Junoniaiphita*	(Cramer)
21		Lemon Pansy	*Junonialemonias*	(Linnaeus)
22		Blue Pansy	*Junoniaorithya*	(Linnaeus)
23		Common Evening Brown	*Melanitisleda*	(Linnaeus)
24		Dark Branded Bushbrown	*Mycalesismineus*	(Linnaeus)
25		Common Bushbrown	*Mycalesisperseus*	(Fabricius)
26		Common Sailer	*Neptishylas*	(Linnaeus)
27		Common Leopard	*Phalantaphalantha*	(Drury)
28		Blue Tiger	*Tirumala limniace*	(Cramer)
	Lycaenidae			
29		Plains Cupid	*Chiladespandava*	(Horsfield)
30		Lime Blue	*Chiladeslaius*	(Stoll)
31		Eastern grass Jewel	*Chiladespulti*	Kollar
32		Zebra Blue	*Leptotesplinius*	Fabricius
33		Common Line Blue	*Prosotasnora*	(C. Felder)
	Hesperiidae			
34		Brown Awl	*Badamiaexclamationis*	(Fabricius)
35		Rice Swift	*Borbocinnara*	(Wallace)
36		Tricolour Pied Flat	*Coladeniaindrani*	(Moore)
37		Common Banded Awl	*Hasorachromus*	(Cramer)

Table - 2 : Species-wise frequencies of butterfly families

Family	Number of Species
Papilionidae	4
Pieridae	5
Nymphalidae	19
Lycaenidae	5
Hesperiidae	4
Total	**37**

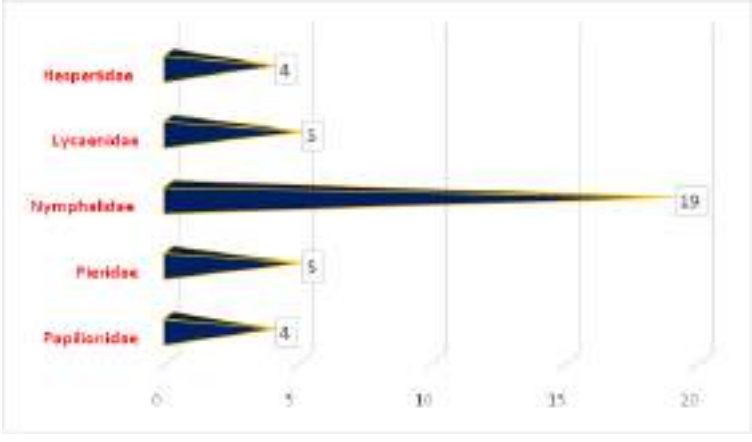

Figure 1. Graphical representation of species-wise frequencies of butterfly families

RESULTS AND DISCUSSION

In current study the total number of butterflies identified were 37 belonging to 5 different families. As stated earlier, the study area holds the potential to accommodate a variety of flora and fauna and with changing seasons, because of the formation of temporary water bodies in and around the study sites, it becomes a favourable spot for the species to thrive. The data of all the species identified is compiled as Table 1.

It is evident from the data that among families, Nymphalidae was the most dominant family with 19 species. It is followed by Pieridae and Lycaenidae families with 5 species each under their name. Papilionidae and Hesperiidae family were the least represented families with 4 species each. The family and the number of species under them is compiled in Table 2 and the graphical representation of the same is as Figure 1.

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INDUCE PARTURITION OF DISTOCIA DUE TO INCOMPLETE CERVICAL DILATION IN CROSSBRED COW

Ngangkham James Singh[1] , Ashok Kumar Yadav[2] and Aslam[3]

Department of Animal Husbandry and Dairying, SHUATS, Prayagraj (U.P)-211007[1]India

Veterinary Medical Officer, Chaka block, Prayagraj (U.P)-211007, India[2]

Shri Vaishnav Vidyapeeth Vishwavidyalaya, Ujjain Road, Indore – 453111, India[3]

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ABSTRACT

Dystocia is difficult for parturition that requires assistance for helping delivery. The causes can be maternal factors (uterine inertia, inadequate size of the birth canal) and or fetal factors (oversized fetus, abnormal orientation as the fetus enters the birth canal). A successful induction of parturition in primiparous HF crossbred cow was carried out with combination of oxytocin and corticosteroid, using valethamate bromide and calcium to deal with ripening of indurated cervix and uterine inertia, respectively. Cow showed dystocia due to indurated cervix and uterine inertia, which was relieved and live male foetus was delivered by correction fetal position and posture by repulsion, adjustment of extremities and traction.

Keywords : *Parturition, dysfosia, cour*

INTRODUCTION

Among all the domestic animals, cattle and buffaloes are considered as species in which incidence of dystocia appears to be highest. Dystocia due to maternal factor is caused either by inadequacies of birth canal or by deficiency of expulsive force (Noakes et al., 2009).Failure of cervix to dilate completely is a common cause of dystocia in large ruminants. The bovine cervix being more muscular, fibrous and tightly closed during pregnancy than in other and tightly closed during pregnancy than in other domestic animals may cause dystocia, if not properly relaxed and dilated (Tillamann, 1960). Failure of cervix to dilate properly may be due to uterine inertia, metritis birth weight of calf, injuries of cervix in previous parturition, and infectious uterine disease debility and debilitation disease (Robert, 1971). And in older cows due to loss of tonicity of uterus or loss of contracting ability of uterus during parturition. Singh et al. (1986) reported 55.8 percent incidence of incomplete relaxation of birth canal in cattle during parturition. In case of dystocia, stenosis or atresia of cervix may occur and cervix may not dilate fully, which may be due to hormonal factors that prevent normal relaxation and dilatation of cervix (Roberts, 1971). Dystocia is one of the most important obstetrical conditions and requires immediate attention by veterinarians. The study reports a case of delayed parturition in a cow due to improper dilatation of cervix cause possibly by hormonal dysfunction.

History and Observations

A primiparous HF crossbred cow presented with history of nine month pregnancy and labour pain initiated day before with no progress. The animal was anorectic for last two days. Defecation and urination were normal. On clinical examination udder engorgement and relaxation of sacrosciatic ligaments were not so prominent. The temperature, pulse rate and respiration rate were within the normal range. After proper restraining, gynaeco-clinical examination was conducted revealing close cervix and live fetus, which was confirmed by various

reflexes per rectally. So, it was decided to manage with induction of parturition.

Fig. No. : 1. Delivery of live fetus by traction

RESULTS AND DISCUSSION

The cow was treated for induced parturition with Inj. Oxytocin (Syntocinon 2ml i/v), Inj Isoflud2mg 5ml i/m, Inj Rintose 20% 500ml i/v , Inj Epidosin (Valethamate bromide 5ml i/m) , Inj Calvit$_{12}$ – 30ml i/m. The cow was examined per vaginally after 24 hours revealing progress in cervical dilatation. The fetus was found in anterior longitudinal presentation with slightly upward deviated head. After mutation of upward deviated head with proper lubrication, mild traction on head and fore legs was applied and a male live foetus could be delivered. After giving a rest of 30 minutes, the cow was reexamined per vaginum andno more fetuses could be felt. The placenta was expelled out naturally after six hours. Following delivery, Inj Intacef tazo-3375gm 10 ml i/m for 5 days, Inj Spasmovet Inj 15 ml i/m for 5 days, Inj calcium borogluconate 250ml i/v for three days, Flurex bolus 2 boli i/u daily for three days, mineral mixture (Ayumin V5) 25gm orally twice daily along with Involon 100ml orally daily for five days. The dam and the calf were found to be completely normal after five days of treatment.

CONCLUSION

In the present case dilation of cervix, associated with primary uterine could be achieved by administration of repeated injection of calcium borogluconate, valethamate bromide, oxytocin and Isoflud. This finds support in observation of Robert (1971), Injection of oxytocin and Inj calvit$_{12}$ might improve tonocity of uterus and aid (K.K Das et al, 2014).

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EFFECT OF WASTEWATER IRRIGATION ON SOIL PROPERTIES AND SEED GERMINATION OF ABELMOSCHUS ESCULENTUS (LADY FINGER) GROWTH

Vandana Mathur and Shilpa Singh
Department of Zoology, C.M.P. P.G. College,
Prayagraj, (U.P.), India

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ABSTRACT

Population growth, massive urbanization, rapid rate of industrialization and modern techniques in agriculture has accelerated water pollution and led to the gradual deterioration of its quality. Wastewater which contain nutrients and organic matter has possible advantages for agriculture purpose. Domestic wastewater is generated continuously and in large quantities. It can serve as an alternative water nutrient source for irrigation. Therefore, the presented study of phsico-chemical properties of wastewater to be used for irrigation purpose and physico-chemical properties of soil prior to irrigation by wastewater. Impact of wastewater irrigation on seed germination when used at different strength. Wastewater were collected from and analyzed for pH, temperature, free CO_2, total alkalinity, chloride. Soil sample were collected from and analyzed pH, temperature, Carbonate, Nitrate. Abelmoschus esculentus was irrigated using wastewater in pot experiment. The concentration of the wastewater 0 %, 20%, 40%, 60%, 80% 100% along with the control water (tap water) were used for the irrigation of the Abelmoschus esculentus. The maximum agronomic performance of the Abelmoschus esculentus was recorded with 40% conc. of the wastewater. Root and shoot length, no. of secondary root maximum of 40% and minimum 100%. Data collected for growth and yield performance include plant height, number of leaf. The effect wastewater seen on nutrient fortication, growth and yield of the plant and the nutrient status of the soil. Wastewater fertigation improved the soil fertility due to increases of pH, Carbonate, Nitrate in the soil and affected the agronomic growth of the A. esculentus was increased from 10 % to 60% concentration of the wastewater in both seasons. Wastewater has agro-fertigant potentiality to supply the plant nutrients needed at higher concentratio*n.***

Keywords: *Domestic wastewater, ladyfinger, seed germination, soil nutrient.*

INTRODUCTION

Rapid growth of urban population results in generation of huge quantity of wastewater perennially. In India only 30 percent of the wastewater is treated before its discharged. Thus, untreated water finds its way into water systems such as rivers, lakes, ground water and coastal waters, causing serious water pollution. On other hand large amounts of water are needed for irrigation in agriculture. If the wastewater can be used as an alternative water source for irrigation both the problems can be solved i.e. application of wastewater to cropland and forest lands. This alternative attractive option for disposal because it can improve is physical properties and nutrient contents of soils. Wastewater irrigation not only provides water but it is also source of N, P and organic matters to the soil. Thus, its use would help in water conservation recycling nutrients of wastewater, reducing direct fertilizer inputs and minimizing pollution. Vegetables are good sources of vitamins, minerals, and fibers which are beneficial for health, growing these requires fertile land, water and other inputs for better yield. Domestic wastewater used by farmers to grow vegetables and salad for nearby urban markets. Such vegetables include carrot, lettuce, cabbage etc. Some of which are consumed raw as salad, however there is always a concern about the contamination and bioaccumulation of potentially toxic elements such as Cd, Cu, Fe, Mn, Pb, and Zn from both domestic and industrial sources (Kiziloglu et al. 2007 by the vegetables. However, treated wastewater can still be used for irrigation under controlled condition to agricultural products, soils, surface, and groundwater. *Abelmoschus esculentus L.* is commonly grown vegetable in suburban areas of Indian cities. Various studies on *A.esculentus* related to seed germination with distillery effluent, hyperaccumulation and mobility of heavy metals impact of sewage irrigation on speciation of nickel in soils and its accumulation in crop, influence of wastewater application on water soil and crop. Ladyfinger is cultivated throughout the tropical and warm temperate regions of the world for its fibrous fruit containing round, white seeds. India rank first in the world with 5784 thousand tones in comparison to Egypt, Saudi Arabia, Mexico. India stood second in production of ladyfinger (79 million metric ton) after china (112 million metric ton). 100 gram of ladyfinger contains about 12.6 gm of protein, 1.5 gm of total fat, 71gm of carbohydrates, 12.2gm of dietary fiber and 3.2 mg of iron.

Rapid growth in population has not only caused an increases in the demand for the limited available freshwater but also caused an increase in the volume of wastewater generated yearly (Thapliyal et al. 2011). The high quality water is preserved and the quality lower is used for agricultural purposes. Irrigation with sewage became a prevalent practice in arid and semiarid regions, where it was readily available and economic to freshwater. Sewage has affected adversely both soil health and crop productivity. In sewage has resulted in improved physicochemical characteristics of soil. In domestic wastewater contains essential plant nutrients such as N, P, K and micronutrients which is beneficial for plants growth. In evaluated the changes in soil parameters after discharging domestic wastewater on soils. Growth of population, massive urbanization, rapid rate of industrialization and modern techniques in agriculture have accelerated the water pollution and led to gradual deterioration of the quality. Due to continuous disposal water into the water body, the surface water quality changes. This surface water is used in the irrigation for crop and the crop is supplied to developing countries. Of the world's

total arable land, 17 percent is irrigated and produces 34 percent of the crop (Pescod 1992).Three quarters of the irrigated area (192 million hectares) is located in developing countries (United Nations 2003) and as a consequence there is high dependence of water for food production frequently in these country. Wastewater is used to irrigate land due to high demand of water (70 percent) by human.

MATERIALS AND METHODS

Collection of water sample

The water samples for evaluation of physico-chemical parameters were collected in 2 liter container. The samples were collected from 6 inches depth at 8:00am to 10:00am in the month of February.

Temperature-

It was measured with the sample thermometer in degree centigrade. The sensor of the instrument is dipped in samples and reading was recorded.

pH

The pH value is determined by dipping the pH paper in given water sample of water.

Chloride

Chlorides increases the electrical conductivity of water and thus increases its corrosivity. In metal pipes, chloride reacts with metal ions to form soluble salts, which increases metal level in drinking water.

Reagent for chloride estimation

Silver nitrate, Potassium chromate

Procedure

Take 50 ml of water sample in a conical flask and add 2ml of potassium chromate. Titrate the contents again 0.02N of $AgNO_3$ until a persistent reddish brown colour appears.

Chloride(mg/l) = (ml.N) of $AgNO_3$x1000x.35 5/vol. of sample.

Free carbon dioxide

Carbon dioxide is product of decomposing bacteria and of respiratory process of plant and animals. It is also added to water by action. Free CO_2 reacts with NAOH forming NaHCO3

Reagent

NaOH solution and Phenolphthalein indicator.

Procedure

Take 50ml of sample in a flask and add 2-4 drop of indicator. If the sample will be colourless then titrate against NaOH solution. Until a pink colour appears

Free CO_2 (mg/L)=vol. of titrant x1000/vol. of sample

Total alkalinity

Alkalinity is measure of water ability to neutralize acidity. An Bicarbonates, Carbonates, and Hydroxide in water and tests results are generally expressgenerally expressed as "ppm" of calcium carbonate ($CaCO_3$). The desirable range of irrigation water is 0 to 100 ppm calcium carbonate.

Procedure

Take 50 ml of water, add 2-3 drops of phenolphthalein indicator. If colour comes titrate till it disappear. If no colour ,add 2-3 drop Methyl orange then titrate till yellow colour.

Total alkalinity =

phen. Or MO((miligm) /lit = ml of titrant used X 1000/100

Soil sampling and analysis

Deformed soil samples of the soil to be used were taken. Sampling and analysis are carried out before planting and after harvesting for each of the different water type used for irrigated the crop during the course of the experiment. The sample were analyses using standard procedure which are soil pH, temp, Carbonate and Nitrate.

Temperature Using soil thermometer and measure temp.

pH

The pH value is determined by dipping the pH paper in soil sample.

RESULTS AND DISCUSSION

Table - 1 : Water Parameters of Waste water & Tap water

Water parameter	wastewater	Tap water
pH	7.11	6.9
Temperature	$30^{O}C$	27°C
Free CO_2	750mg/l	450mg/l
Chloride	445.25mg/l	260mg/l
Alkalinity	195mg/l	160mg/l

Soil parameter

Temperature - $30^{O}C$

pH - 7.2

Carbonate - less effervescence

Nitrate - less amount of nitrogen

IMPACT OF WASTEWATER IRRIGATION ON LADYFINGER

A pot culture experiment was carried out study the defect of different concentration of sewage sludge on the yield and yield components of ladyfinger a clay loam soil. For the experiment, wastewater of different concentration was applied at 0%, 20%, 40%, 60%, 80%, 100%, (v/v) strength on seeds of ladyfinger sown in different pots continuously for 45 days. The physico-chemical characteristics of that soils were assessed prior application of wastewater and also after the irrigation by wastewater for 45 days. Also, 6 Petri dishes were taken along with filter papers at their each Petri dishes, 8 seed of ladyfinger were placed, distantly. They were marked 0 %, 20%, 40%, 60%, 80%, 100%, those seeds were also wetted by the wastewater of Allahpur sewage treatment plant respective strengths. It was continued for one week. After then the small plants from the Petri dishes were analyzed in regard of various parameters like germination percentage, root length, shoot length etc. to check the suitability of wastewater on seed germination Similarly the plants planted in different pots having 1 kg of soil were irrigated with respective strength of wastewater. Those plants were removed from after 45 days and then their different parameters were analyzed for different concentration.

ANALYSIS OF PLANTLETS GROWN FROM SEEDS PLOTTED ON PETRIDISHES AND IRRIGATED BY WASTEWATER

The seeds grown in different Petri dishes were irrigated with wastewater of different strength. Germination was highest in 0% and 40% strength i.e. of germination. The root length also the maximum shoot length (mm) was of 40 strength plantlets i.e. 18±2mm and minimum was of 100% i.e. 6±2 mm. The number of secondary roots were maximum in plantlets of 40 %strength i.e. 4 and minimum in 100 strength i.e.2.

Table - 2 : Percentage of germination growth parameters & No. of secondary roots

Conc.	germination%	Root length (mm)	Shoot length (mm)	No. of sec. root
0%	100%	16±2	13±3	4
20%	80%	14±3	10±2	3
40%	100%	18±2	14±2	4
60%	60%	10±2	7±2	2
80%	70%	12±2	8±3	3
100%	30%	8±2	6±2	2

Plotting of seeds in pots

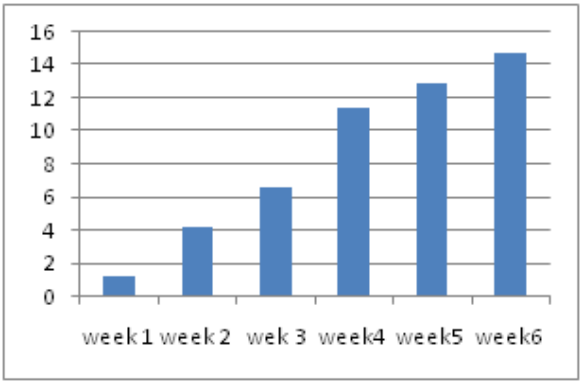
Analysis of plant growth irrigation by wastewater after 45 days

Table - 3 : Plant height(cm) per week when irrigated with wastewater

Samples	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
0%	1.5	4.3	7.4	10.3	12.3	15.2
20%	1.7	5.6	8.6	11.2	14.5	16.6
40%	1.4	3.8	5.3	12.4	13.6	12.3
60%	1.2	5.2	8.7	15.3	16.3	18.6
80%	1.3	4.3	6.4	14.2	13.4	14.9
100%	0.4	2.1	3.2	5.2	7.7	10.8
Av.	1.25	4.21	6.6	11.4	12.9	14.7

Plant height

The response of the plant height to the irrigation of the water type can be seen in graph below. The height of the plant irrigated with waste water.

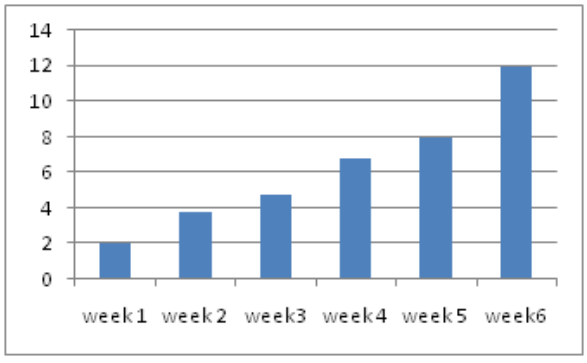


Variation in plant height(cm) per week (WWAvg).

Table - 4 : No. of leaves per week when irrigated with treated wastewater

samples	Week 1	Week 2	Week 3	Week 4	Week 5	Wee k6
0%	2	3	4	6	7	12
20%	2	4	5	8	9	13
40%	2	5	6	9	11	14
60%	2	4	4	7	8	10
80%	2	4	6	6	7	15
100%	2	3	4	5	6	8
Av.	2	3.8	4.8	6.8	8	12

Graph below shows the comparison between the number of leaves of each plant irrigated with wastewater (WWAvg).



Variation in no. of leaves per week

CONCLUSION

The physico-chemical analysis of wastewater revealed that it is highly polluted and its quality can be improved by various wastewater treatment by recycling and reusing it for irrigation. *A. esculentus* was able to obtain its nutrient requirement in enhancing the growth of plants. Wastewater fertigation improved the soil fertility due to increases of pH, Carbonate, Nitrate in the soil and affected the agronomic growth of the *A. esculentus* was increased from 10 % to 60% concentration of the wastewater in both seasons. Wastewater has agro-fertigant potentiality to supply the plant nutrients needed at higher concentration. Therefore, the wastewater can be used after its appropriate dilution irrigation purpose to achieve the maximum yield of this crop. The treated wastewater discharged by activated sludge process-based treatment plant can be utilized to provide the nutrients required *by A. esculentus* to produce the maximum crop yield.

Due to rapid increasing of population and development, the availability of clean water is decreasing. Fertilizer costs are also they were various long lasting side effects on the health of

human and environment. Soil treated with 80 % concentrated waste water sample, shows positive impact on its physico- chemical properties, in comparison to other concentrations. The plant grown at 40 % concentration shows maximum no. of leaves shoot length and root length in comparison to other concentration, while at 100% concentration most of seeds died.

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EFFECT OF DIFFERENT TREATMENTS OF TULSI LEAVES DECOCTION AS PRE-MILKING UDDER WASH OF COWS ON BACTERIOLOGICAL QUALITY OF RAW MILK

Kartikey Patel*, Ramesh Pandey, Aslam*** and Deepak Verma******

*Department of LPM, **SHUATS Prayagraj, (U.P.), India

***Department of Animal Husbandry & Dairying, SVVV Indore, , (M.P.), India

**** K. P. Higher Education Institute, Jhalwa, Prayagraj, (U.P.), India

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ABSTRACT

The present study was undertaken to find out the effect of different treatments of Tulsi leaves decoction as pre-milking udder wash of cows on bacteriological quality of raw milk on 12 healthy cross-bred cows at SHUATS, dairy farm. All experimental animals were housed in tail-to-tail barn under similar managemental condition. All sanitary precautions were undertaken to produce clean milk by dry full hand method of milking. Representative samples of milk were collected in different pre-hand milking udder wash treatments as, T0 (Udder of cows washed prior to hand milking with clean water and wiped off with clean towel as control), T1(Udder of cows washed prior to milking with tulsi decoction, prepared by boiling. 50 g green tulsi leaves in 1 litre water for 10 minutes then), T2 (Udder of cows washed prior to milking with tulsi decoction, prepared by boiling 75g green tulsi leaves in 1 liter water for 10 minutes), T3 (Udder of cowswashed prior to hand milking with Tulsi decoction, prepared by boiling 100g green tulsi leaves in 1 liter water for 10 minutes). Milk samples were analyzed to determine standard plate count (SPC), Lactic acid bacterial count (LABC), Lipolytic bacterial count (LBC), Proteolytic count (PBC) and coliform in milk Statistical analysis of different bacterial parameters from pre-milking udder wash treatments of tulsi decoction revealed significant in SPC, LABC, LBC, and PBC but shown non-significant difference in coliform count of milk. Results of the experiment clearly indicated the bacteriological quality of raw milk adjudged on the basis of SPC and physiological groups of bacteria was best in T3 followed by T2, T1 and control indicating there by superiority of T3 over rest of the pre-milking udder wash treatment of Tulsi decoction.

Keywords : *Tulsi, effect, raw milk*

INTRODUCTION

Agriculture is the cultivation and breeding of animals, plants and fungi for food, fiber, biofuel, medicinal plants and other products used to sustain and enhance human life. Agriculture was the key development in the rise of sedentary human civilization, whereby farming of domesticated species created food surpluses that nurtured the

development of civilization. The study of agriculture is known as agricultural science. Animal husbandry not only refers to the breeding and raising of animals for meat or to harvest animal products (like milk, eggs, or wool) on a continual basis, but also to the breeding and care of species for work and companionship. The livestock sector is a crucial component of India's economy in terms of incomes,employment, equity and foreign exchange. It contributes about 4.11% GDP and 25.6% of total agricultural GDP in India (livestock commission 2012). Global plea for foods of animal origin is budding and it is obvious that the livestock sector will need to further expand FAO, (2009). Livestock production systems can be defined based on feed source, as grassland based, mixed, and landless. As of 2010, 30% of Earth's ice- and water-free area was used for producing livestock, with the sector employing approximately 1.3 billion people. Between the 1960s and the 2000s, there was a significant increase in livestock production, both by numbers and by carcass weight, especially among beef, pigs and chickens, the latter of which had production increased by almost a factor of 10. Non-meat animals, such as milk cows and egg-producing chickens, also showed significant production increases. Global cattle, sheep and goat populations are expected to continue to increase sharply through 2050.

MATERIALS AND METHODS

From the herd consisting of crossbred cows, only twelve healthy cows free from mastitis as detected by Californian Mastitis test (Schalm and Noorlender, 1957) and other noticeable udder infection or injuries were randomally selected for this experiment. Experimental cows were housed in tail-to-tail barn prepared for milking and dry, full hand method of milking was followed. Samples of milk were collected from different four treatments of pre milking udder wash with tulsi leaves decoction. In all ten replications were made under each treatment. Milk samples were tested for determining the total bacteria in raw milk by standard plate bacterial count (SPC) and population density of four physiological groups of bacteria viz. lactic acid bacterial count (LABC), Lipolytic bacterial count (LBC), and Coliform count.

Collection of samples

Milk samples were collected in different treatments of milk pre –milking udder wash separately in sterile 250 ml capacity conical flasks and plugged aseptically with cottonplug. Those milk samples were then brought immediately to laboratory for determination of bacterial quality of raw milk.

Pre-milking Treatments

(T) of udder wash under the experiment:

T0: Udder of cows washed prior to hand milking with clean water and wiped off with clean towel as control.

T1: Udder of cows washed prior to hand milking with Tulsi decoction (prepared by boiling 50/g green Tulsi leaves in 1 liter water for 10 minutes then filtered) and wiped off with clean towel. **T2:** Udder of cows washed prior to hand milking with Tulsi decoction (prepared by boiling 75/g green Tulsi leaves in 1 liter water for 10 minutes then filtered) and wiped off with clean towel. **T3:** Udder washed prior to hand milking with Tulsi decoction (prepared by boiling 100/g green Tulsi leaves in 1 liter water for 10 minutes then filtered) and wiped off with clean towel.

Parameters of study:

Following were the bacterial parameters determined as per method of Chalmers (1953).

Standard plate count/ml (SPC) for total bacteria

Lactic acid bacterial count (LABC)

Proteolytic bacterial count (PBC)

Lipolytic bacterial count (LBC)

Coliform count

Sterilization of glassware:

Conical Flasks: Prior to use all the conical flasks were thoroughly cleaned, dried, plugged with absorbent type cotton and then sterilized in autoclave at 120o C for an hour.

Pipettes: Prior to use all the bacteriological pipettes of 1 ml and 10 ml capacity were immersed in chromic acid solution overnight, washed with tap water and dried. They were wrapped in paper and sterilized in hot air oven at 120 0C for an hour.

Test tubes: Test tubes ware washed thoroughly with detergent and tap water. Then test tubes were used for preparing 9 ml blanks of Ringer's solution for dilution of the sample. They were plugged with sterile absorbent cotton and then sterilization in autoclave at 1200 C at 1.2 kg/cm2 for 20 minutes.

Petri plates: These were thoroughly washed with detergent then tap water and kept on a clean table in inverted position for drying. Dried plates were wrapped in paper in block of 4 in each. These sterilized in hot air oven at 120^0C for an hour.

RESULTS AND DISCUSSION

Table: Mean values of bacterial count per ml in raw milk as influenced by different pre-milking udder wash treatments of Tulsi leaves decoction.

Bacteria/ml	Mean Values of different bacterial parameters as influenced by different pre-milking udder wash treatments				Results
	T0	T1	T2	T3	Significant(S) Nonsignificant NS)
SPC (10^4)/ml	a 38.6	b 32.7	c 33.9	d 31.2	S
LABC (10^2)/ml	a 31.3	b 29.6	c 28.2	c 28.1	S
LBC (10^2)/ml	a 34.2	b 28.5	c 29.4	d 25.7	S
PBC (10^2)/ml	a 25.6	b 22	c 21.3	d 19.5	S
Coliforms/ml	a 00.00	a 00.00	a 00.00	00.00	NS

Figures with similar alphabets shows non-significant difference between the values within the parameter.

- Lowest mean SPC (10^4) per ml was observed as 31.2 in milk of T3 followed by 32.7 in T1, 33.9 in T2 and 38.6 in T0. The differences in these values ware significant.
- Lowest mean LABC (10^2) per ml milk was recorded as 28.1 in T3 followed by 28.2 in T2, 29.6 in T1 and 31.3 in T0.The differences in these values of LABC were found significant.
- Lowest mean LBC (10^2) per ml milk was recorded as 25.7 in T3 followed by 28.5 in T1, 29.4 in T2 and 34.2 in T0. The difference in these values were found significant.
- Lowest mean PBC (10^2) per ml milk was 19.5 in T3 followed by 21.3 inT2, 22 in T1 and 25.6 in T0. The differences in the values of PBC were found significant.
- Lowest mean Coliforms (10) per ml milk was observed as nil in (T3, T2, T1, T0) all treatment. The differences in the values of coliform were non-significant.

CONCLUSION

The results of the study revealed significant effect of different pre-hand milking treatments of

Tulsi leave decoction as pre-milking udder wash on Standard Plate Count, Lactic Acid Bacterial Count, Proteolytic Bacterial Count and Lipolytic Bacterial Count expect Coliforms count in raw milk. Overall rating of quality of raw milk as determined by various bacterial parameter was found best inT3 indicating its superiority over reaming pre-hand milking treatments of udder wash Therefore use of Tulsi decoction as pre- hand milking udder wash may (prepared by boiling 100g green Tulsi leaves in 1 liter water for 10 minutes then filtered) be recommended to the daily farmers as an alternative of costly antiseptic solution available in the market to produce milk of low bacterial count.

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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON NUTRITIONAL VALUE OF RADISH LEAF (RAPHANUS SATIVUAS. L) CV. KASHI SHWETA

Manoj Kumar Singh
Department of Horticulture
Kulbhaskar Ashram Post Graduate College, Prayagraj , (U.P.), India

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ABSTRACT

The experiment on Radish was conducted in the department of Horticulture, Kulbhashkar Ashram Post Graduate college, Prayagraj during 2018-19. Radish leaves are very rich source of nutrient. Its leaves are consumed directly in salad and other culinary purposes. Nutritional value of leaf was significantly influenced by organic matter and bio-agents. Highest carbohydrate level (3.69g/100g fresh leaf) was in T9 (Azotobactor+PSB) treatment. Lowest carbohydrate level (2.90g/100g leaf) was recorded in control. Similarly, Potassium level (300mg/100gleaf) was highest in T9. Sodium absorption was also highest in T9 treatment.

Keywords : *INM, effect, kashi, shweta*

INTRODUCTION

The nutrient content of radish leaf is significantly depended on soil fertility. The nutrients present in the leaf are directly related to the fertility level of soil. The integrated nutrient management system approach, utilizes a judicious combination of inorganic fertilizer and organic manure build soil fertility and to increase the production of crop (Kumar et *al.* 2013). In India radish is cultivated on area of 206.00 (000 ha) with total production of 3252.00 (000MT) during 2018-19 as per NHB data base. It is cultivated throughout India, mostly in West Bengal, Bihar, U.P., M.P, Punjab, Assam, Haryana, Gujarat, and. H.P. In U.P. In U.P. Jaunpur district is popular in production and quality of radish **Radish *(Raphanus sativus L.)*** is a popular root vegetable in both tropical and temperate regions of Cruciferae (Brassicaceae) family grown all over world. In India, it is widely cultivated in northern and southern plains as well as in hills. Radish (2n=18) is grown for its young tender fusiform root which is consumed either raw as salad or cooked as a vegetable.The integrated nutrient management system approach, utilizes a judicious combination of inorganic fertilizer and organic manure build soil fertility and to increase the production of crop (Kumar et *al.* 2013). In India radish is cultivated on area of 206.00 (000 ha) with total production of 3252.00 (000MT) during 2018-19 as per NHB data base. It is cultivated throughout India, mostly in West Bengal, Bihar, U.P., M.P, Punjab, Assam, Haryana, Gujarat, and. H.P. In U.P. In U.P. Jaunpur district is popular in production and quality of radish

MATERIALS AND METHODS

Field experiment entitled "Effect of Integrated Nutrient Management on nutritional value of Radish leaf (Raphanus Sativus L.)" was conducted at the Horticulture Farm K.A.P.G. Allahabad Utter Pradesh during rabi season 2019-20. The details of the procedure adopted for Crop raising and criteria used for treatment evaluation during entire course of investigation are described here. The experiment consists of 8 treatments combinations comprising of organic manures with and without biofertilizer (viz. NPK liquid consortia Bio). The details are as below.

Table - 1 : Details of treatments used in study.

S. NO.	Treatment symb.	Treatment detail
1.	T_0	Control unit (no use fertilizer)
2.	T_1	Azotobactor
3	T_2	PSB(phosphorus soluble bacteria)
4.	T_3	FYM@10t/ha
5.	T_4	Vermicompost@4t/ha
6.	T_5	FYM+Azotobactor
7.	T_6	FYM+PSB
8.	T_7	Vermicompost+Azotobactor
9.	T_8	Vermicompost+PSB
10.	T_9	Azotobactor+PSB

RESULTS AND DISCUSSION

The results of the field experiment were carried out to study. The "Effect of Integreted Nutrient management on nutritional value of Radish leaf (Raphanus Sativus L.)" conducted at Horticulture Farm. Kulbhaskar Ashram Post Graduate College, Allahabad, Utter Pradesh are presented in this chapter.

Carbohydrate content:

Carbohydrate content of the leaf is the indicator of high quality leaf. Carbohydrate includes both fibres and monosaccharide. This not only enhances taste but also facilitates to reduce constipation. Therefore radish is now taken as a medicinal produce rather than agricultural one. Carbohydrate content was found to vary significantly with the treatments. The lowest value was recorded in control. All the treatments were significantly superior over control. The content was in the range of 2.4-3.69 g per 100 g of fresh leaf. Organic matter was found to influence the carbohydrate content . Table 2 gives the clear picture of the influence of the treatments on carbohydrate content. **Ziaf *et al.* (2015):** reported that number of leaves per plant root fresh weight and yield and leaf carbohydrate content were significantly higher to combined application PSB+RDF. Root diameter increased when RDF was used along with PSB in radish. **Randy (2016)**: evaluated the effect of different varying level of vermicompost on growth and yield of radish cv. 'Snow White' and reported that the treatment T4 (15t/ha vermicompost) obtained the tallest plant (39.67cm), more no. of leaves (13.04 or 14 leave), largest root diameter (2.91 cm) and longest root was generated by T3 (10t/ha vermicast) with 19.73 cm while T4 measuring at 19.58 cm long and total root yield showed T4 obtaining the highest plot yield, and leaf nutrient increased.

Table - 2 : Effect of INM (biofertilizer and organic manures) on carbohydrate of leaf

S. NO.	Treatment symb.	Treatment detail	Carbohydrate(in g) per 100g of leaves
1.	T_0	Control unit (no use fertilizer)	2.4
2.	T_1	Azotobactor	2.9
3	T_2	PSB(phosphorus soluble bacteria)	3.01
4.	T_3	FYM@10t/ha	3.11
5.	T_4	Vermicompost@4t/ha	3.12
6.	T_5	FYM+Azotobactor	3.41
7.	T_6	FYM+PSB	3.45
8.	T_7	Vermicompost+Azotobactor	3.59
9.	T_8	Vermicompost+PSB	3.66
10.	T_9	Azotobactor+PSB	3.69
		SEm±	0.01
		CDat5%	0.02

Potassium content:

Potassium content of the leaf is the indicator of high quality leaf. Potassium has significant effect on human health. This not only enhances taste but also facilitates to faster growth. Therefore radish is now taken as a medicinal produce rather than agricultural one. Potassium content was found to vary significantly with the treatments. The lowest value was recorded in control. All the treatments were significantly superior over control. The content was in the range of 201-300 mg per 100 g of fresh leaf. Organic matter was found to influence the potassium content . Table 3 gives the clear picture of the influence of the treatments on potassium content. **Menka Pathak, *et al* (2017)** On the basis of present investigation, it may be concluded that the adoption of either safe production (T7) or conventional practices (T4) increased the growth, yield and nutritional quality of radish in radish coriander cropping sequence **P. Jaisankar(2018)** The effect of integrated nutrient management on growth and yield of radish *(Raphanus sativus L.)* cv. pusa chetki. The experiment was laid out in Randomized Block Design with three replications and ten treatments. The treatment combination consisted of a organic manures (FYM and Vermicompost) Bio-fertilizer (Azospirillum) and Plant bio regulator (Humic acid).

Table - 3 : Effect of INM (biofertilizer and organic manures) on potassium of leaf

S. NO.	Treatment symb.	Treatment detail	Potassium(in mg) per 100 g of leaves
1.	T_0	Control unit (no use fertilizer)	201
2.	T_1	Azotobactor	202
3	T_2	PSB(phosphorus soluble bacteria)	208
4.	T_3	FYM@10t/ha	220
5.	T_4	Vermicompost@4t/ha	240
6.	T_5	FYM+Azotobactor	260
7.	T_6	FYM+PSB	280
8.	T_7	Vermicompost+Azotobactor	285
9.	T_8	Vermicompost+PSB	290
10.	T_9	Azotobactor+PSB	300
		SEm±	1.01
		CDat5%	1.02

Sodium content:

Sodium content of the leaf is the indicator of high quality leaf. Sodium increases the body weight through good absorption of other nutrients. This not only enhances taste but also facilitates to reduce tension. Therefore radish is now taken as a medicinal produce rather than agricultural one. sodium content was found to vary significantly with the treatments. The lowest value was recorded in control. All the treatments were significantly superior over control. The content was in the range of 23-39 mg per 100 g of fresh leaf. Organic matter was found to influence the sodium content . Table 4 gives the clear picture of the influence of the treatments on sodium content. **Devendra Kumar Sahu, Khiromani Nag and LP Bhardwaj (2018)** To entitled Effect of integrated nutrient management on growth and yield of radish *(Raphanus sativus L).*The experiment consisting of ten treatment combination with NPK, Vermi-compost, FYM, as well as poultry manure was laid out in randomize block design with three replications. Growth parameter differed significantly at all the stages of crop growth. Maximum plant height (13.76, 25.45, 30 and 45 DAScm), number of leaves per plant (4.36, 6.15, 30 and 45 DAS), were recorded in the treatment (T7) NPK 50% + poultry manure1.5t/ha. Maximum length of root (28.03), fresh weight of leaves (150.81g), fresh weight of root (150.81g), root yield per hectare (22.82 q), were recorded in the same treatment. Combined Application of NPK 50% + poultry manure also increased the growth and yield parameter of radish. **T. Shormin and M.G. Kibria (2019)** Application of urea, cow dung digestate, and poultry manure digestate, raw cow dung and raw poultry manure increased plant height, number of leaves plant-1 ; fresh and dry weight of shoot of leafy radish cv. Saisai, Hybrid. Addition of the organic amendments in combination with urea

showed comparatively better results than their individual application. Application of 50%N from urea+ 50%N from raw poultry manure may be recommended for leafy radish cultivation with a hazardless environment.

Table - 4 : Effect of INM (biofertilizer and organic manures) on sodium of leaf

S. NO.	Treatment symb.	Treatment detail	Sodium(in mg) per 100g of leaves
1.	T_0	Control unit (no use fertilizer)	23
2.	T_1	Azotobactor	24
3	T_2	PSB(phosphorus soluble bacteria)	24
4.	T_3	FYM@10t/ha	26
5.	T_4	Vermicompost@4t/ha	29
6.	T_5	FYM+Azotobactor	30
7.	T_6	FYM+PSB	33
8.	T_7	Vermicompost+Azotobactor	34
9.	T_8	Vermicompost+PSB	36
10.	T_9	Azotobactor+PSB	39
		-	0.32
		CDat5%	0.62

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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON ROOT YIELD AND ECONOMY OF RADISH (RAPHANUS SATIVUAS. L) CV. KASHI SHWETA

Surya Narayan
Department of Horticulture
Kulbhaskar Ashram Post Graduate College
Prayagraj, (U.P.), India

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ABSTRACT

The experiment on Radish was conducted in the department of Horticulture, Kulbhashkar Ashram Post Graduate College, Prayagraj during 2018-19. The best result (40,02t/ha) was observed in T1 (FYM@10/ha). The next best result (38.13t/ha) was in T3 (NPK Liquid consortia@100 ml/10 kg seed)treatment. Net income was also highest with T1 treatment followed by T3 treatment .Lowest yield and income was recorded in control. Organic matter seems to play critical role in radish root development. Bioagents also have significant impact on root yield.

Keywords : *JNM, radish, effect*

INTRODUCTION

The integrated nutrient management system approach, utilizes a judicious combination of inorganic fertilizer and organic manure build soil fertility and to increase the production of crop (Kumar et *al.* 2013). In India radish is cultivated on area of 206.00 (000 ha) with total production of 3252.00 (000MT) during 2018-19 as per NHB data base. It is cultivated throughout India, mostly in West Bengal, Bihar, U.P., M.P, Punjab, Assam, Haryana, Gujarat, and. H.P. In U.P. In U.P. Jaunpur district is popular in production and quality of radish **Radish *(Raphanus sativus L.)*** is a popular root vegetable in both tropical and temperate regions of Cruciferae (Brassicaceae) family grown all over world. In India, it is widely cultivated in northern and southern plains as well as in hills. Radish (2n=18) is grown for its young tender fusiform root which is consumed either raw as salad or cooked as a vegetable.The integrated nutrient management system approach, utilizes a judicious combination of inorganic fertilizer and organic manure build soil fertility and to increase the production of crop (Kumar et *al.* 2013). In India radish is cultivated on area of 206.00 (000 ha) with total production of 3252.00 (000MT) during 2018-19 as per NHB data

base. It is cultivated throughout India, mostly in West Bengal, Bihar, U.P., M.P, Punjab, Assam, Haryana, Gujarat, and. H.P. In U.P. In U.P. Jaunpur district is popular in production and quality of radish

MATERIALS AND METHODS

Field experiment entitled "Effect of Integrated Nutrient Management on root yield and economy of Radish (Raphanus Sativus L.)" was conducted at the Horticulture Farm K.A.P.G. Allahabad Utter Pradesh during rabi season 2019-20. The details of the procedure adopted for Crop raising and criteria used for treatment evaluation during entire course of investigation are described here. The experiment consists of 8 treatments combinations comprising of organic manures with and without biofertilizer (viz. NPK liquid consortia Bio). The details are as below.

Table - 1 : Details of treatments used in study

S. NO.	Treatment symb.	Treatment detail
1.	T_0	Control unit (no use fertilizer)
2.	T_1	Azotobactor
3	T_2	PSB(phosphorus soluble bacteria)
4.	T_3	FYM@10t/ha
5.	T_4	Vermicompost@4t/ha
6.	T_5	FYM+Azotobactor
7.	T_6	FYM+PSB
8.	T_7	Vermicompost+Azotobactor
9.	T_8	Vermicompost+PSB
10.	T_9	Azotobactor+PSB

RESULTS AND DISCUSSION

The results of the field experiment were carried out to study. The "Effect of Integreted Nutrient management on root yield and economy of Radish (Raphanus Sativus L.)" conducted at Horticulture Farm. Kulbhaskar Ashram Post Graduate College, Allahabad, Utter Pradesh are presented in this chapter.

Total yield per hectare (Tonnes):

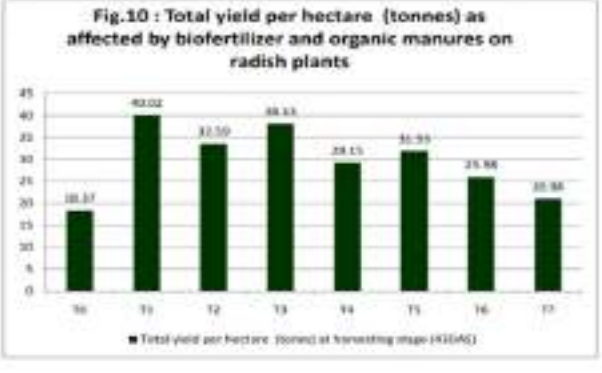
Total yield per hectare at harvesting stage of radish. Perusal of data presented in Table 2 . The maximum average yield per hectare (40.027 tonnes) recorded in (T1 plot, FYM) 40.027 tonnes followed by (38.13 tonnes) T3 Plot (NPK liquid consortia).

Respectively, minimum yield per hectare (18.372 tonnes) in T0 (control unit) followed by (20.98 tonnes) T7 plot (FYM+Vermicompost+ NPK liquid consortia).

Rani *et al.* (2006) reported that the significantly higher plant height (39.99cm), shoot to root ratio (1.70) and girth (7.74cm) the fresh weight (40.48g per plant) and dry weight (3.51 g per plant) were lowered with compare to sole crop carrot. Further, among the different integrated nutrient management practices, application of Neem cake and castor cake in combination with half the recommended dose of NPK recorded higher yield (14.71 and 15.86 t/ha) and quality compared to other organic manures, such as vermicompost and farm yard manures. Kore et al. (2006) reported that plant height and number of leaves per plant in garlic were found maximum in plants receiving combined nutrients dose @ 10 t FYM+ 3kg Azotobacter + 3kg PSB+ 75 percent RDF per ha. Patil *et al*. (2007) reported that the significantly higher plant height and number of seed stalks per plant in onion were recorded with the application of FYM @ 10, 15 and 20t per ha than 5t/ha.

Table -2 : Effect of INM (biofertilizer and organic manures) on yield per hectare radish.

Treatments	Root yield ($t\ ha^{-1}$)	Gross income ($Rs\ ha^{-1}$)	Expenditure Rs (ha^{-1})	Net income ($Rs\ ha^{-1}$)	C:B Ratio
FYM @10 $t\ ha^{-1}$	40.02	100050	37550	62500	1:2.66
Vermicompost @4 $t\ ha^{-1}$	33.59	83975	48550	35425	1:1.72
NPK Liquid Consortia @100ml/10 kg seed treat.	38.13	93325	52610	60715	1:2.64
FYM+Vermicompost (5 t+2t) ha^{-1}	29.15	72875	43050	29825	1:1.69
FYM+NPK liquid (5t/ha+50ml/10 kg seed treat.)	31.93	79825	35080	44745	1:2.27
Vermicompost + NPK liquid (5t/ha+50ml/10 kg seed treat.)	25.98	64950	40580	24370	1:1.60
FYM+VC+NPK liquid (3.33t/ha+1.33t/ha+33.33 ml/10 kg seed treat.)	20.98	52450	39554.9	12895.1	1:1.32



Economics:

The data pertaining to economics of the treatments are depicted in the Table 3 and cost of cultivation incurred in various treatments is presented in Appendix-IV and V. Adhikari (2009) reported that highest benefit cost ratio was observed in organic farming system. Than the organic production of carrot economically profitable in respect to inorganic production system. Ngullie et al. (2009) recorded that plant height of onion is higher with FYM @30t/ha (30.3-45.2cm) as compared to FYM @ 30 t/ha + Azotobacter (26.3-41.7cm) or pig manure @ 20 t/ha (25.0-41.7cm). Vijaya kumari *et al.* (2009) reported that the effect of some organic manure like herbal microfertilizer, humic acid, FYM and biofertilizer with NPK on growth parameters of carrot. Among the parameters observed the germination percentage was highest in FYM treated plots on 7 DAS (Days after sowing) and in NPK treated plots on 21, 28, 30 DAS. The parameters such as crown length, root length and vigour index were studied on 30, 60,90 and 120 DAS. The root length on 60 and 120 DAS was increased by FYM where on 30, 90, DAS inverse was observed in NPK treated plots. Highest vigour was in FYM treated Plots on 30 DAS.

Table - 3 : Economics of the treatments.

Treatment Symbol	Treatments Details	Total yield per hectare (tonns)-
T_0	Control unit (No use of fertilizer)	18.37
T_1	FYM @10t/ha	40.02
T_2	Vermicompost @4t/ha	33.59
T_3	NPK Liquid consortium (Biofertilizer) @ 100ml/10kg seed treatment.	38.13
T_4	(5 tonnes FYM+ 2 tonnes Vermicompost)/ha.	29.15
T_5	5 tonnes FYM/ha+ 50ml NPK liquid consortium (Bio fertilizer)/10 kg seed treat.	31.93
T_6	2 tonnes Vermicompost/ha+ 50ml NPK Liquid consortium (Bio fertilizer)/10 kg seed treat.	25.98
T_7	3.3 tonnes FYM/ha+ 1.33 tonnes vermicompost/ha +33.33ml NPK liquid consortium/10 kg seed treat.	20.98
	SEm ±	**3.38**
	C.D. at 5% level	**10.28**

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ENVIRONMENTAL SUSTAINABILITY: AN APPROACH TOWARDS ENVIRONMENT AND AGRICULTURE

S.N Sharma* and Ashwani Kumar Patel[1]

*Department of Plant Pathology, N.P.G College, Barhalganj, Gorakhpur, (U.P.), India

[1]Department of Mycology and Plant Pathology, BHU, Varanasi, (U.P.), India

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ABSTRACT

Environmental sustainability (ES) is the aim towards environment and Agriculture progress. Environmental sustainability is the responsibility to conserve natural resources and protect global ecosystems to support health and wellbeing, now and in the future. It covers a wide range of issues starting from a specific location to global isues. Global issues comprise concerns about GHG mitigation, climate change, and renewable energy, while the location-specific issues are soil erosion, water management, soil quality, and air and water pollution. Environmental impact of Assessment is tool to evaluate potential impact of any gives activity on the environmental to plant appropriate measures to reduce adverse effects and augment positive affects and augment positive effects. The environmental impact assessment is predictive exercise aimed at forecasting the environmental issues and related socio-economic impact. The management strategies for re-establishment environment and sustainable development as environment sustainability approach towards environment and agriculture which leads to food security with agriculture development utilization of resources judiciously which are in limited form.

Keywords: *Sustainable, environment, agriculture, global warming*

INTRODUCTION

Concept of environmental sustainability Environmental sustainability is the responsibility to conserve natural resources and protect global ecosystems to support health and wellbeing, now and in the future.

Sustainable development (SD) should integrate social, environmental, and economic sustainability and use these three to start to make development sustainable.

Environmental sustainability seeks to sustain global life-support systems indefinitely. Protecting human life is the main reason anthropocentric humans seek environmental sustainability.

These source and sink capacities are large but finite; sustainability requires that they be maintained rather than run down. Overuse of a capacity impairs its provision of life-support service. Human life depends on other species for food, shelter, breathable air, plant pollination, waste

assimilation, and other environ- mental life-support service.

The three types of sustainability-social, environmental, and economic-are clearest when kept separate. We seek to focus the definition of environmental sustainability (ES), partly by distinguishing ES from social sustainability and from economic sustainability. The challenge to social scientists is to produce their own definition of social sustainability, rather than load social desiderata on to the definition of ES. Similarly with economic sustainability; let economists define it or use previous definitions of economic sustainability.
Environmental sustainability (ES) is the goal; sustainable development can be one part of the means to approach that goal. The Sustainable development may be defined as development without growth in throughput of matter and energy beyond regenerative and absorptive capacities or it can be also defined as Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Environmental sustainability covers a wide range of issues starting from a specific location to global. Global issues comprise concerns about GHG mitigation, climate change, and renewable energy, while the location-specific issues are soil erosion, water management, soil quality, and air and water pollution. The role of biofuel in the dimension of environmental sustainability is largely to reduce GHG emissions (e.g., CO2, methane, N2O), though there are controversies regarding its effectiveness. The leading sources of GHG emissions for non-CO2 GHGs are agricultural practices like the use of fertilizer, soil tillage, pesticides, irrigation practices, and harvesting. The environmental sustainability of the food sector is affected by air and water pollutants emissions, land-use change, fresh water exploitation and climate change. New industrialized form of agriculture and farming are extremely energy-intensive and overexploit natural resources at a rate that not respect the fragile ecosystems' equilibrium (Galli et al., 2017; FAO, 2012a).

Environmental sustainability is the ability to maintain the qualities that are valued in the physical environment. Sustainability issues arise wherever there is a risk of difficult or irreversible loss of the things or qualities of the environment that people value. And whenever there are such risks there is a degree of urgency to take action. Environmental sustainability programs include actions to reduce the use of physical resources, the adoption of a 'recycle everything/buy recycled' approach, the use of renewable rather than depletable resources, the redesign of production processes and products to eliminate the production of toxic materials, and the protection and restoration of natural habitats and environments valued for their livability or beauty. Some of the issues that pose major environmental sustainability problems include-

- ❖ destruction of the living environments (habitats) of native species
- ❖ discharge of polluting chemicals and other materials into the environment
- ❖ emission of greenhouses gases into the atmosphere than can cause climate change
- ❖ depletion of low cost oil and other fossil fuels

The meanings of related terms with Environment sustainability will be explored in this paper

- ❖ 'sustainability' and 'ecologically sustainable development'
- ❖ Physical environment

The physical environment includes the natural and biological environments. Physical environments can be considered on all scales from

the micro to the local, global and even larger. Physical surrounds physical resources.

The scientific evidence is clear: human consumption has already exceeded earth's regenerative capacity (Wackernagel et al., 2002), it becomes clear that the survival of scores of species—including our own—is threatened, all sciences, but especially the applied sciences, have a duty to work towards a solution, At this point in human history, it is time to contribute to ensure the sustainability of our planet. Sustainability as the ultimate goal—"living within the regenerative capacity of the biosphere" (Wackernagel et al., 2002) is important topic in environment issue. Degradation of the natural environment; declining fossil fuel reserves; loss of natural habitats and biodiversity; climate change; population growth; natural disasters; agricultural problems(e.g., loss of soil, availability of arable land); the impact of industrial production, mining, and agricultural activity on local ecosystems; pollution; and water scarcity have been well documented and researched by leading scientists around the world .

This mentioned issue is major threats in environment sustainability. Convergent and interlinked threats to environmental well being and integrity include unsustainable lifestyles and consumption patterns in "developed" nations, exponentially increasing and profligate non-renewable energy use,

Industrial pollution, human population pressures, habitat destruction and biodiversity loss, decreasing agricultural productivity, overharvesting in natural environments, conflict and war, and other cumulative and convergent human contributions to climate change. The impacts and long term consequences of these environmental impacts are far reaching, ultimately catastrophic, and wholly unsustainable. (Reser, 2007)

Potential solutions to address these environmental threats, such as the creation of sustainable products, processes, and practices to replace ecologically harmful ones, are forthcoming, albeit at a slower rate than necessary to curb further damage. It is self-evident that most of our planet's important natural resources are limited, and that degradation and consumption without conservation or replenishment will deplete and eventually exhaust them. Therefore, sustainability must be our concern, at least in the long term. Natural resources, water, air, arable land, raw materials, energy, and biodiversity, among others, are essential elements for humanity's existence on earth and for economic activity. Being "green" makes good business sense (Holme, Watts, & World Business Council for Sustainable Development, 2000).

Agriculture and environment are interlinked to each other The increased food supply during last four decades in many parts of India has increased national food security. It has also steered the nation through the years when natural calamities were severe, there have been several other spins of this huge agricultural growth including environment protection. It has made a marked impact on the conservation of forest resources of our country. If the yield improvement would not have taken place we would at present have required another 70 million ha of land to produce the food grains to meet our requirements. Since the land is finite this additional land would have come from deforestation. Thus productivity improvement associated with the green revolution can also be described as forest or land saving agriculture. Indian agriculture is however once again at crossroads facing tremendous new challenges due to continuous population growth, stagnation in farm level productivity in intensive farming areas and globalization, By 2050 country population is

expected to grow about 1.6 billion. This rapid and continuing increase in population implies a greater demand for food. Even though there is pressure to increase food production, there are reports of increasing problems of environment degradation in agriculture fields especially in intensive cultivated region such as the indo gangetic plane. There is great concern now about decline soil fertility, decline in water table and irrigation water quality rising salinity and resistance of pest to many pests to many pesticides. The problem of agriculture environment is getting further complicated due to other development activities. Rapid industrialization and urbanization in the different parts of country leading to generation of untreated waste water which are often disposed in rivers, lakes, canals.

Establishment of industries such as thermal plants in peri urban area results in emission of large amount of aerosols. All these are increasingly causing problem of soil, air, and water pollution affecting structure and functioning of the agro ecosystem. Over the past few decades the man induced changes in the climate of the earth have also become the focus of the scientific and social attention. The most important of the environmental changes on the earth is the increase in the atmospheric temperatures due to increase level of Green house gases and pollution with increase in the level of CO_2 due to deforestations. The quantity of rainfall and its occurrence has also become more uncertain.

Nowadays due to climate change various damages has been caused due to cyclones and flood in irregular manner in various parts of India, In latest news the Cyclone Tauktae caused damages in Goa and Gujarat. The storm has claimed at least 15 people dead and many people's are missing, with very strong winds and heavy rainfall it damaged nearly 16,500 houses and uprooted 40,000 trees. The summer crop was completely damaged and horticultural plants and other plants had been damaged. Cyclone claimed that with loss of lives it left trail of destruction in the saurashtra region after it made landfall near Una in Gir somnath district. Likewise much destruction had been occurred due to global warming and climate change.

All these changes would have tremendous impact on climate on agricultural production and hence food security of any reason. Producing enough food for the increasing population against the background of reducing resources in adverse environmental scenarios against the background of reducing resources in adverse environmental scenarios while minimizing further environmental degradation is therefore the primary task of agriculture. To identify the existing and emerging constraints limiting productivity and opportunities for sustainable increase in future, it is important to understand agriculture- environment interaction in totality. This includes identification of the key environmental problems from an agricultural perspective impact of these on agriculture, impact of agricultural activities on the environment and restoration of environment of agriculture.

Environmental impact of Assessment: is tool to evaluate potential impact of any gives activity on the environmental to plant appropriate measures to reduce adverse effects and augment positive affects and augment positive effects. The environmental impact assessment is predictive exercise aimed at forecasting the environmental issues and related socioeconomic impact. To assess the environmental impact of agriculture on the scale of farming region six methods are used depending on the objectives.

- Environmental risk mapping
- Life cycle Analysis
- Environmental impact assessment
- Multi-agent system

- Linear programming
- Agro-environmental indicators

Indices for environmental monitoring

Air Quality Index a number ranging from 0 to 500 used to characterize the quality of the air at the given location.

Environmental sustainability it is a composite index tracking different element of environment sustainability covering natural resources endowments past and present pollution level, environmental managements efforts contribution to protection of global commons and society capacity to improve its environmental performance over time.

Environmental performance index: a method of qualifying and numerically benchmarking the environmental performance of country policies.

Global warming potential: An index defined as the cumulative radioactive forcing between the present and some chosen later time horizon caused by unit mass of gas emitted now.

Environment Restoration: There are several methods which can be adopted for re-establishment of environment and agriculture. Some methods are Carbon sequestration, conservation agriculture, crop diversification, Amelioration of polluted environment and renewable source of energy, use of biodiesel crops, and agriculture waste management etc.

CONCLUSION

Global environment change has been serious threat to the existence of mankind; Environmental sustainability is an approach for meeting the present requirement without harming the future resources. The environmental restoration will help in sustainable development and pollution free environment.

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PACKAGE OF INNOVATIVE FACILITIES FOR THE WELFARE OF GOATS

D. V. Singh[1], S. K. Singh[2], R. K. Sharma[3], Brijesh Singh[4] and Anil Kumar[5]

Department of Livestock Production Management

College of Veterinary and Animal Sciences

GB Pant University of Agriculture & Technology, Pantnagar – 263145, Uttarakhand, India

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ABSTRACT

Department of Livestock Production Management, CVASc., GBPUAT, Pantnagar developed a package of facilities to enrich welfare needs of goats. This package includedSlatted Aerated Mattress (SAM), Kids' Cradle (KC), Kids' Brooding Chamber (KBC) and Silvi-pasture (SP). SAM, KC and KBC are designed for comfortable housing of goats, whereas SP is designed for round the year availability of nutritious green fodder. These facilities carried innovative ideas behind their development. As a result of using these facilities, there was improvement in general health conditions and overall performance of kids as well as goats as reflected by studies carried out. Goat farmers and other visitors appreciated these facilities as the principle behind these was easy to understandby them and replicate at their units. Consequently, many goat keepers have translated the conceptsin to reality at their goat units with minor modifications. Presently, all these facilities are acting as good source of information to UG/ PG scholars as well.

Keywords : *Pantja, goats, welfare, slatted aerated mattress, kids' cradle, kids' brooding chamber, silvipasture*

INTRODUCTION

Today goat is an important livestock in the economy of every country. India possessed 148.9 million goats (14.4% share of world) during the year 2019 (All India Livestock Census-2019) and they have increased by 10.1% from the year 2012, indicating their overall usefulness. Much has been said about goats in the ever-swelling literature, but very little on their welfare needs, requirements and preferences.

Goats are sensitive to climatic variations. Behaviorally they are agile, curious, exploratory, choosy(for food and shelter), sporty and friendly to human. Hence, raising goats by providing with facilities which satisfy their behavioral needs is essentially an art.

Since raising goats is easier than raising large ruminants, they are the animals of choice among the poor. A large number of goat keepers exist in Indiabut majority of them do not have technical knowhow to rear goatsscientifically and profitably. Consequently, they rear goats by following traditional housing system. Hence, there is need to develop cost effective innovative live

demos which goat keepers can appreciate, easily adopt and get benefitted.

Department of Livestock Production Management, College of Veterinary and Animal Sciences, G.B. Pant University of Agriculture & Technology, Pantnagar (Uttarakhand) maintains a flock of about 80 Pantjagoats, the breed thathas recently been recognized with accession No. INDIA_GOAT_2420_PANTJA_06024. Since 2014 these animals are reared as nucleus flock for further improvement and propagation in field under ongoing ICAR-All India Coordinated Project on Goats. Previous to AICRP on goats, LPM department successfully carried out two projects on goats funded by DBT, New Delhi and RKVY-Uttarakhand during the year 2006-2010 (Singh and Sharma, 2020).

As a result of the mandates assigned under various projects as well as due to the motivation, the department has been able to develop a number of innovative,cost effective and easy to adopt facilities, like:Slatted Aerated Mattress (SAM), Kids' Cradle (KC), Kids' Brooding Chamber (KBC) and Silvi-pasture (SP) for the overall welfare of goats. Description of these facilities is given below:

1. Slatted Aerated Mattress (SAM)

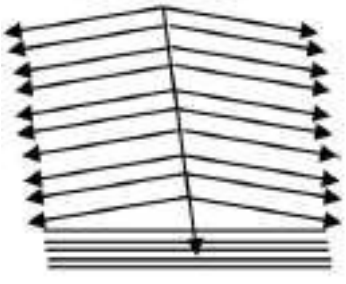
I. Need — Goats do not take rest in wet areas resulting from urination, defecation, washings or rain. Consequently, they keep searching dry and comfortable place, andremain standing for most of the time if such an area is not available. This is reflected by their poor growth and worm infestation through contact with faeces, etc.

ii. Aim — To provide comfortable and hygienic housing facility for goats.

iii. Principle — Goats have natural instinct to rise over to the elevated,dry and comfortable surfaces for rest.

iv. Structure — Slatted Aerated Mattress is made up of three components:

1. The gallery (1.0 m wide on all sides) for movement and cleaning, and keeping goats away from jumping over to side walls
2. Iron angle trusses at 75 cm height,to support the wooden mattress above
3. Mattress of 5.5x2.75 m size, made up of 70 Sheesham (*Dalbergia sissoo*) strips of 135x10 x 2 cm each, placed in two rows (35+35) and screwed to truss below bykeeping a gap of 2 cmin between two strips. ThisMattress has a gradientlengthwise and also laterally (outwards) from mid longitudinal ridge. In order to form a ramp, a total of 7 such strips are fixed in inclined manner at lower end of the mattress, which encouragedgoats for an easy ride over the mattress and step down safely.



v. Application/ use — All the goats, above 2 month age,were allowed to enter in to the pen having SAM and all of them rose over to the platform instinctively using the ramp. Initially, the goats were encouraged by the leader and subsequently there was no need of any stimulus.Goats remained on the platform and rested for longer periods in night and noon hours. Their faeces and urine passed down easily through the slits, keeping the goats dry and healthy. Passing of urine and faeces down to floor as well as cleaning of the mattress was easy due to slits between strips and the two-directional gradient.Replacement of damaged strip with fresh one was also easy due to use of the screw.

vi. Advantages

1. The mattress was found clean and dry for most of the time and goats used it automatically for comfort and rest (Khare, 2005).
2. Goats were found healthier and their parasitic load,in terms of EPGcount, got significantly reduced which madethem more productive(Thapaliyal, 2017).
3. Goat keepers tested the efficacy of the mattressduring their routine visits (Fig.2). They utilised the principle and developed the mattress at their end as per the infrastructure facilities available with them.
4. The facility has been incorporated as part of practical syllabus of BVSc.&AH and BSc.(Ag) degree programs.
5. It has become an important piece of information to subject matter experts and farmers during Kisan Melas, Review meets, etc.

vii. Clientele — Goat keepers, Scholars and Researchers

Fig.1 Goats on SAM

Fig.2 Visiting goat keepers

Fig.3 Students' learning

Fig.4 Adoption of SAM's concept in field

2. Kids' Cradle (KC)

I. Need — Kids need protective housing as they are prone to predators as well as theft. Kids also need ample sunlight during winters for their good health and well being.

ii. Aim — To protect kids from predators and theft as well as to provide them ample sunlight during winters.

iii. Principle — Kids could be kept in enclosures at suitable site without obstructing their vision for long.

iv. Structure — Construction of KC has following components:

1. Select a suitable site which offers maximum sunlight and protection from predators.
2. Make a foundation at an elevation of about 30 cm from the ground level to fix the iron nettings.
3. Get an iron netting of 325 x 120 cm size,having squares of 2.5x2.5 cm, weld an iron strip on its both the edges to provide strength and grip while fixing. Fold the netting to give it a circular shape, and then fix it in the foundation. Thus, thediameter and height of the enclosure will become325 and 120 cm, respectively, to accommodate 12-20 kids, depending upon the age.
4. A window of 60x75 cm from bottom edge at suitable point is desirable before fixing the netting. This window permits easy entry and exit to kids as well as to the operator. The window should preferably have a locking device.
5. Finally, the facility has an iron pole (8-10 cm diameter, 200 cm long) fixed upright in the centre, having a few iron hooks at its top to hang fodder; and 6-8 bars radiating from it to peripheral edge to shield the housed kids from scorching sunlight and rain.
6. Dimension of the netting and pole could be changed according to the site and need.
7. Circular shape of the KC provides strength to the structure, helps in easy cleaning/ draining and prevents injury to exploratory/ playful kids.

v. Application/ use — Initially kids needed guidance to enter the KC. Subsequently, they automatically entered in it, enjoyed and obtained fodder.

vi. Advantages

1. The device kept animals protected and healthy.
2. The KC facility is simple but very useful, particularly where goat keepersare unable to give personal attention to growing kids.
3. KC saved time and labour both while handling the kids otherwise.
4. The facility has been incorporated as part of practical syllabus of BVSc.&AH and BSc.(Ag) degree programs.

vii. Clientele Goat keepers, Scholars and Researchers

Fig.5 Kids' Cradle

Fig.6 DDG(AS) & Team

Fig.7 Students' learning

Fig.8 Visiting goat keepers

Fig.9Adoption of KC concept in high hills

3. Kids' Brooding Chamber (KBC)

I. Need — Winter is the deadliest season for kids' survivability in plains and hills both, where kids' mortality may amount to even 20% in field. Thus, protection of kids during chilly winters was important for goat keepers.

ii. Aim — To provide a cost effective, cosy, temperature regulated chamber to kids during night time.

iii. Principle — Kids prefer a cosy and temperature regulated chamber during winters.

iv. Structure — A rectangular enclosure of 2.5 x 2.5 x 1.25m was already available in the unit as kidding pen. Following additions were made to develop it as KBC:

1. Plywood (5 mm) sheets were cut into 4 triangles (sides), and joined at top to form canopy over the enclosure, with a central maximum height of 2.0 m.
2. Four bulbs of 100w each were fitted inside each side of the canopy. These bulbs could be operated upon one by one from outside.
3. One side of the canopy was slit to form sliding window (30 x 30 cm), enabling to watch comfort level of kids inside KBC. The window was also used to regulate the ventilation.
4. Inside temperature of the chamber could be regulated by illuminating the bulb(s)fitted inside the canopy.
5. KBC supported housing of 10-12 kids up to 4 months age in winter. Bedding of paddy straw was provided to enhance comfort level.

v. Application/ use — Initially kids needed guidance to enter the KBC. Subsequently, they automatically entered in it and enjoyed the cosy microclimate of KBC.

vi. Advantages

1. Kids were found healthier and their mortality rate was reduced at the unit.
2. The facility has been incorporated as part of practical syllabus of BVSc. & AH and BSc.(Ag) degree programs.

vii. Clientele — Goat keepers, Scholars and Researchers

Fig.10 Kids' Brooding Chamber

Fig.11 Students' learning

Fig.12 Visiting goat keepers

Thapaliyal (1917) studied performance of Pantja kids till age at first mounting while housing them on SAM, KC and KBC. She found that kids kept under these innovative housing structures had significantly ($P<0.05$) higher values for body weight (12.18±0.11 *vs*. 10.73±0.09 kg), chest girth (54.24±0.10 *vs*. 52.10±0.21 cm), body length (48.42±0.13 *vs*. 47.10±0.36 cm), haemoglobin (10.44 ±0.32 *vs*. 09.48 g) and survival rate (99.9 *vs*. 85.7%) and lower values of faecal egg count (10.44±0.32 *vs*. 09.48±0.32 g/dl) and coccidial ova (10.44 ±0.32 *vs*. 09.48 g) and average age at first mounting (154.0±4.16 *vs*. 133.0±3.53 days) than control. The study indicated positive role of innovative housing facilities in Pantja kids.

4. Silvi-pasture (SP)

I. Need — Goat can consume dry matter up to 6% of its body weight, the highest among all livestock species. If judiciously planned, goat flock can be raised on green fodder alone for most of the time and then it reduces cost on their raising. Hence, there is a need to develop pasture land which could provide balanced diet throughout the year.

ii. Aim — To develop silvi-pasture for year-round availability of varietal and nutritious fodder.

iii. Principle — Goats are basically browsers and fond of varietal fodder, which could be grown together as silvi-pasture.

iv. Structure — An area of about 2 acres land adjacent to goat unit was earmarked in the year 2007-08 to develop it in to silvi-pasture. On this land, 7 bunds were made at 5 m distance lengthwise, to plant saplings of Ardu (*Ailanthus excelsa*), Ber (*Ziziphus indica*),Jamun (*Syzigiumcumini*),Kachnar (*Bahuniavariegata*), Litchi (*Litchi chinensis*), Mango (*Magnifeta indica*),Mulberry (*Morus rubra*) and Napier (*Peninsetum purpureum*), which attain different heights and bloom during different seasons of the year. Mixed crop of 'Oats + Berseem' and 'Cowpea + Maize' were also sown in between the bunds during autumn and summer seasons, respectively. Silvi-pasture has been

protected by mulberry bio-fence, which also encouraged browsing by goats.

v. Application/ use — Development of silvi-pasture took about 5 years. This ensured all round availability of fodder to goats as well as to other livestock. Goat flock on their release from shed prefer to rush towards silvipasture.

vi. Advantages

1. Year round availability of nutritious green fodder was assured.
2. Animals showed good health and growth and lower parasitic load.
3. SP reduced cost on supervision and losses due to predators when compared with grazing in open pasture land.
4. The facility has been incorporated as part of practical syllabus of BVSc.&AH and BSc.(Ag) degree programs.
5. Visitors get motivation to develop similar facility at their goat unit.

vii. Clientele — Goat keepers, Scholars and Researchers

Fig.13 Initial plantation

Fig.14 Initial plantation

Fig.15 Visiting goat keepers

Vaidehi (2019) conducted a trial onArdu (*Ailanthus excelsa*) leaves, obtained from silvipasture,powdered and used them to partially replace the concentrate feed for studying the performance ofPantja goats. She observed that such feeding significantly improved body weight, hemoglobin concentration, mean corpuscular hemoglobin, total erythrocyte count, packed cell volume, lymphocyte per cent, serum HDL, serum protein profile and serum calcium in goats. Further, such feeding significantly reduced serum glucose, total cholesterol, LDL cholesterol, tryglycerides, AST, ALT and fecal egg count in goats. She found best results when 75% concentrate feed was replaced with Ardu leaf powder, which also reduced overall feed cost. Vandana *et al*. (2014a, 2014b) studied performance traits of Pantja goats including their milk quality under farm conditions at Pantnagar and observed positive effect of the above facilities on these traits.

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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON SEED GERMINATION AND COST BENEFIT RATIO OF RADISH (RAPHANUS SATIVUAS. L) CV. KASHI SHWETA

Manoj Kumar Singh
Department of Horticulture
Kulbhaskar Ashram Post Graduate College
Prayagraj, (U.P.), India

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ABSTRACT

The experiment on Radish was conducted in the department of Horticulture, Kulbhashkar Ashram Post Graduate college, Prayagraj during 2018-19.Seed is a costly input. It also determine stand in the field. All the treatments were significantly better over control. Organic matter as well as bio-inoculants has great impact on embryo emergence. Highest germination percentage (89.51) was recorded in T8 (vermicompost +PSB). Cost benefit ratio was highest with FYM@10 tonne per hectare.NPK Liquid consortia@100 ml/10 kg seed treatment was also at par the best treatment.

Keywords : *INM, radish, seed germination*

INTRODUCTION

The integrated nutrient management system approach, utilizes a judicious combination of inorganic fertilizer and organic manure build soil fertility and to increase the production of crop (Kumar et *al.* 2013). In India radish is cultivated on area of 206.00 (000 ha) with total production of 3252.00 (000MT) during 2018-19 as per NHB data base. It is cultivated throughout India, mostly in West Bengal, Bihar, U.P., M.P, Punjab, Assam, Haryana, Gujarat, and. H.P. In U.P. In U.P. Jaunpur district is popular in production and quality of radish Radish *(Raphanus sativus L.)* is a popular root vegetable in both tropical and temperate regions of Cruciferae (Brassicaceae) family grown all over world. In India, it is widely cultivated in northern and southern plains as well as in hills. Radish (2n=18) is grown for its young tender fusiform root which is consumed either raw as salad or cooked as a vegetable.The integrated nutrient management system approach, utilizes a judicious combination of inorganic fertilizer and organic manure build soil fertility and to increase the production of crop (Kumar et *al.* 2013). In India radish is cultivated on area of 206.00 (000 ha) with total production of 3252.00 (000MT) during 2018-19 as per NHB data base. It is cultivated throughout India, mostly in West Bengal, Bihar, U.P., M.P, Punjab, Assam,

Haryana, Gujarat, and. H.P. In U.P. In U.P. Jaunpur district is popular in production and quality of radish

MATERIALS AND METHODS

Field experiment entitled "Effect of Integrated Nutrient Management on seed germination and cost benefit ratio of Radish (Raphanus Sativus L.)" was conducted at the Horticulture Farm K.A.P.G. Allahabad Utter Pradesh during rabi season 2019-20. The details of the procedure adopted for Crop raising and criteria used for treatment evaluation during entire course of investigation are described here. The experiment consists of 8 treatments combinations comprising of organic manures with and without biofertilizer (viz. NPK liquid consortia Bio). The details are as below.

Table - 1 : Details of treatments used in study

S. NO.	Treatment symb.	Treatment detail
1.	T_0	Control unit (no use fertilizer)
2.	T_1	Azotobactor
3	T_2	PSB(phosphorus soluble bacteria)
4.	T_3	FYM@10t/ha
5.	T_4	Vermicompost@4t/ha
6.	T_5	FYM+Azotobactor
7.	T_6	FYM+PSB
8.	T_7	Vermicompost+Azotobactor
9.	T_8	Vermicompost+PSB
10.	T_9	Azotobactor+PSB

RESULTS AND DISCUSSION

The results of the field experiment were carried out to study. The "Effect of Integreted Nutrient management on seed germination and cost benefit ratio of Radish (Raphanus Sativus L.)" conducted at Horticulture Farm. Kulbhaskar Ashram Post Graduate College, Allahabad, Utter Pradesh are presented in this chapter.

Seed Germination:

Seed germination was significantly influenced by treatments taken into considerations. Lowest seed germination was recorded in control. Other treatments were significantly superior over control. Seed germination range was 78.94-89.51. organic matter seems to solublize stored food material of seed readily and quickly which seems to be precursor of growth hormones like NAA and Gibbrellic acid. Seed being costly input need to be used economically so that cost of cultivation maybe reduced significantly. Findings are in confirmity with the findings of scientists.

Padamwar and Dakore (2010): Studied the effect of vermicompost, farmyard manure and biofertilizer on the nutritional quality of Cole crops and found that there was significant increase in percentage dry matter, protein, carbohydrate, Vit-C, and calcium contents curd of all the cole crops due to application of vermicompost fertilizers. Japtoo *et al.* (2013): reported that the application of bio-slurry manure generally improved growth, yield and quality of carrots. Application of 7.8t/ha of bio-slurry increased yields by 8.8% in season 1 and 23.5% in season 2 compared to control unit. Leaf numbers, Plant height, dry weight of shoot and root were also generally higher for the 7.8t/ha treatment composed to other treatments.

Table 2 : Effect of INM (biofertilizer and organic manures) on seed germination of radish.

S. NO.	Treatment symb.	Treatment detail	Germination percentage
1.	T_0	Control unit (no use fertilizer)	78.94
2.	T_1	Azotobactor	83.33
3	T_2	PSB(phosphorus soluble bacteria)	84.11
4.	T_3	FYM@10t/ha	83.44
5.	T_4	Vermicompost@4t/ha	84.44
6.	T_5	FYM+Azotobactor	86.77
7.	T_6	FYM+PSB	86.93
8.	T_7	Vermicompost+Azotobactor	89.41
9.	T_8	Vermicompost+PSB	89.51
10.	T_9	Azotobactor+PSB	89.33
		SEm±	0.13
		CDat5%	0.22

Cost Benefit Ratio:

The data pertaining to economics of the treatments are depicted in the Table 3 and cost of cultivation incurred in various treatments is presented in Appendix-IV and V. Adhikari (2009) reported that highest benefit cost ratio was observed in organic farming system. Than the organic production of carrot economically profitable in respect to inorganic production system. Ngullie et al. (2009) recorded that plant height of onion is higher with FYM @30t/ha (30.3-45.2cm) as compared to FYM @ 30 t/ha + Azotobacter (26.3-41.7cm) or pig manure @ 20 t/ha (25.0-41.7cm). Vijaya kumari *et al.* (2009) reported that the effect of some organic manure like herbal microfertilizer, humic acid, FYM and biofertilizer with NPK on growth parameters of carrot. Among the parameters observed the germination percentage was highest in FYM treated plots on 7 DAS (Days after sowing) and in NPK treated plots on 21, 28, 30 DAS. The parameters such as crown length, root length and vigour index were studied on 30, 60,90 and 120 DAS. The root length on 60 and 120 DAS was increased by FYM where on 30, 90, DAS inverse was observed in NPK treated plots. Highest vigour was in FYM treated Plots on 30 DAS.

Table - 3 : cost benefit ratio of the treatments

Treatments	Root yield ($t\ ha^{-1}$)	Gross income ($Rs\ ha^{-1}$)	Expenditure $Rs\ (ha^{-1})$	Net income ($Rs\ ha^{-1}$)	C:B Ratio
FYM @10 $t\ ha^{-1}$	40.02	100050	37550	62500	1:2.66
Vermicompost @4 $t\ ha^{-1}$	33.59	83975	48550	35425	1:1.72
NPK Liquid Consortia @100ml/10 kg seed treat.	38.13	93325	32610	60715	1:2.64
FYM+Vermicompost (5 t+2t) ha^{-1}	29.15	72875	43050	29825	1:1.69
FYM+NPK liquid (5t/ha+50ml/10 kg seed treat.)	31.93	79825	35080	44745	1:2.27
Vermicompost + NPK liquid (5t/ha+50ml/10 kg seed treat.)	25.98	64950	40580	24370	1:1.60
FYM+VC+NPK liquid (3.33t/ha+1.33t/ha+33.33 ml/10 kg seed treat.)	20.98	52450	39554.9	12895.1	1:1.32

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ODONATE DIVERSITY AT GUN CARRIAGE FACTORY ESTATE JABALPUR, MADHYA PRADESH

Shivam Dubey*, Hemlata Pant, Shiv Ji Malviya*****

*Govt. Science College, Jabalpur, Madhya Pradesh, India

**Deparment of Zoology, CMP PG College, Prayagraj-211002, (U.P.), India

***Deparment of Zoology, H.N.B. Degree College, Naini, Prayagraj, (U.P.), India

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ABSTRACT

The current study is performed at the Gun Carriage Factory Estate situated in Jabalpur district of Madhya Pradesh. The odonates are known to act as biological indicators thus playing a very critical role in the maintenance of the health of any ecosystem. The area under study is a protected area due to many security reasons hence, it is very much free from human interference. The study identified 24 species pertaining to 6 families of Odonata order.

Key words: *GCF, odonata, diversity*

INTRODUCTION

Biodiversity loss is one among the world's most pressing crises and there's world concern regarding the biological resource on which most human life depends. To target the conservation of biological diversity that has recently received attention. varied studies and protocols are projected to check the patterns of the same (Noss, 1990; Enrlich and Wilson, 1991) and Vane Wright *et al*., (1991) conjointly classified a stratified composition of various level of organization furthermore as teams of taxonomically connected species to check the patterns of biodiversity conservation. The employment of indicator taxa in conservation efforts from pollution management to biological diversity has been the main focus of attention (Landres *et al*., 1988). Ecological indicators will be outlined as a taxonomic group or community that reflects the biotic or abiotic state of any ecosystem (Hodkinson and Jackson, 2005). Larval odonate diversity and abundance were completely related to macroinvertebrates diversity and abundance and it had been economical bioindicators of a variety of overall macroinvertebrates (Foote and Rice, 2005).

The order Odonata had been well-studied order worldwide. Order Odonata is a diverse group of true bugs. However, families of those insects go back to the higher Jurassic period and Cretaceous periods (150-60 million years ago) (Westfall and May 1996). Dragonflies and damselflies can be regarded among the foremost engaging creatures on earth. These can be discovered close to the ponds, lakes, rivers, ditches, and marshes. Dragonflies (suborder- Anisoptera) have a broadhead with

convergent separated eyes. Wings tend to be dissimilar; hind wings remain loosely expanded at the bottom and dissent in venation from forelimbs. Dragonflies belong to Odonata and are regarded as the ancient of winged insects (Ramesh *et al*., 2010; Oliver and Beattie, 1993) and Chandra et al., (2021).

Around 6000 species of odonate has been described worldwide by Silsby (2001). Similarly, 5,952 species and sub-species of odonate fauna had been recorded by Schorr and Paulson (2014). The odonate diversity of Northern India has been described by Fraser (1933 to 1936) wherein he described 536 species. The Indian subcontinent presently is host to 3 sub-orders, 17 families, 139 genera, and 499 species of damselflies and dragonflies (Prasad and Varshney, 1995). 499 species were recorded by Mitra (2005) while Subramanian (2009) confirmed the identification of 463 species across India. In the context of protected areas of Madhya Pradesh, Raju, and Narayanan, 2008 reported 46 species from Kanha NP while Mishra (2009) identified 32 odonate species from Bandhavgarh NP. Similarly, Ramkrishna *et al*. conducted the surveys in Pench as well as Satpura National Parks and reported 24 and 11 species of odonates respectively. 14 species from Panchmarhi Biosphere Reserve were established by Prasad and Mishra (2009). Talmale (2011) recorded 26 species from Singhori Wildlife Sanctuary.

MATERIALS AND METHODS

Observations were taken by walking through the study site with the help of binocular and digital cameras. This study is predicated on the odonate population. Unidentified and uncollected Odonata were sighted and collected with the help of a butterfly net and were kept in paper triangles in the field. The paper triangles were dipped in acetone for killing the live insect and overnight kept in acetone for preservation. Live photos were additionally taken as they were caught within the field. The adult specimens were identified with the assistance of literature: Fraser, (1933; 1934; 1936), Mitra, (2002; 2006; 2008), Mitra, *et al*., (2006, 2012), Subramanian, (2005), Subramanian (2009), and St. Andrew *et al*., (2009).

RESULTS AND DISCUSSION

The study at GCF Estate, Jabalpur revealed 24 species of odonates belonging to 6 families. Of these, the sub-order Zygoptera have 9 species under 3 families while on the other hand, 15 species belonging to 3 families of sub-order Anisoptera were identified. The Zygopteran families included Coenagrionoidae, Platycnemididae, and Lestidae. Out of these Coenagrionoidae were represented by 6 species, followed by Lestidae (2 species) and Platycnemididae (1 species). Similarly, the Anisopteran families involved Aeshnidae, Gomphidae, and Libellulidae. Among these Libellulidae being the most dominant represented by 10 species, followed by Gomphidae (3 species) and Aeshnidae (2species). The same is compiled as Table 1. The names of all the species recorded are compiled in Table 2. The graphical representation of the same is given in Figure 1.

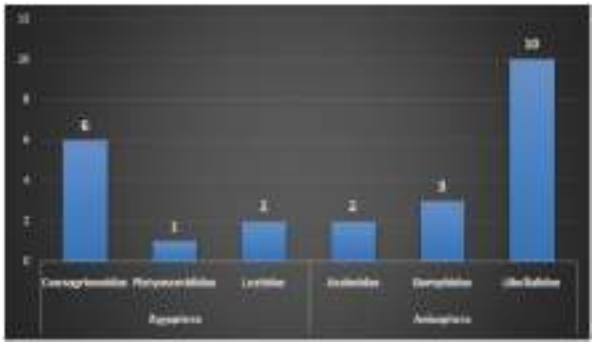
Table : 1 - Families recorded under both sub-orders

Odonata	**Zygoptera**	Coenagrionoidae	6
		Platycnemididae	1
		Lestidae	2
	Anisoptera	Aeshnidae	2
		Gomphidae	3
		Libellulidae	10

Table : 2 - Name of families recorded during the survey

Order: Odonata	
Sub order: Zygoptera (Damselflies)	
Coenagrionoidae	*Agriocnemis pygmaea* (Rambur, 1842)
	Ischnura senegalensis (Rambur, 1842)
	Pseudagrion rubriceps (Selys, 1876)
	Pseudagrion decorum (Rambur, 1842)
	Ceriagrion coromandelianum (Fabricius, 1798)
	Rhodischnura nursei (Morton,1907)
Platycnemididae	*Copera marginipes* (Rambur, 1842)
Lestidae	*Lestes umbrinus* (Selys,1891)
	Lestes elatus (Hagen in Selys,1862)
Sub-order: Anisoptera (Dragonflies)	
Aeshnidae	*Anax guttatus* (Burmeister, 1839)
	Gynacantha bayadera Selys,1891
Gomphidae	*Ictinogomphus rapax* (Rambur, 1842)
	Macrogomphus annulatus (Selys,1854)*
	Paragomphus lineatus (Selys,1850)
Libellulidae	*Acisoma panorpoides* (Rambur, 1842)
	Brachythemis contaminata (Fabricius,1793)
	Bradinopyga geminata (Rambur, 1842)
	Crocothemis servilia (Drury, 1770)
	Diplacodes trivialis (Rambur,1842)
	Neurothemis intermedia (Rambur, 1842)
	Orthetrum sabina (Drury, 1770)
	Pantala flavescens (Fabricius, 1798)
	Trithemis aurora (Burmeister, 1839)
	Trithemis festiva (Rambur, 1842)

Figure 1. Odonate families recorded in the study



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VALUE ADDITION OF JACKFRUIT: A REVIEW

Neeraj Gupta*
Division of Food Science and Technology
Chatha, SKUAST-Jammu-180009, India
*

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ABSTRACT

Jackfruit (*Artocarpus heterophyllus* Lam.) belongs to the family Moraceae and commonly known as *Kathal*. To utilize the surplus fruits available during the season and to improve the livelihood of the farmersvalue added products can be developed from Jackfruitwhich will also enable the farmers to improve their income.The surplus fruits could be provided to the fruit processing industries in their region which can produce the value-added products on large scale. The various products which could be developed from jackfruit are candy, finger chips, fruit bars, fruit leather, halva, papad, ready-to-serve beverages, toffee and milk-based srikhand, ice cream,kulfi, *etc*. The focus of this review is to provide information on the research work undertaken about jackfruit, and to provide the basic information for future commercialization and utilization of this fruit.

Keywords : *Jack fruit, value, product*

INTRODUCTION

Jackfruit (*Artocarpus heterophyllus* Lam.) is an important underutilized fruit and often called the poor man's fruit because of its affordability and availability in large quantities during the season. The fruit often assumes the role of a secondary staple food as well as contributes to the livelihoods of the poor. Jackfruit (Kathal) is an integral part of common Indian diet and is freely available in Indian and adjoining continents, its medicinal properties are also mentioned in *Ayurveda*. The poor people of jack fruit growing area, used to eat this fruit instead of rice, for one of the daily meals. People consumed it mostly as a fruit when ripe but also as a vegetable in the unripe stage. Jack fruit significantly contributes to the nutrition of the people of this country as source of vitamins, minerals and calories. Both tender and ripe fruits as well as the seeds are rich in minerals and vitamins. It is grown and sold in the market almost whole the year in the country. However, the fruit is perishable and cannot be stored for long time because of its inherent compositional and textural characteristics (Molla*et al*. 2008 and Gupta *et al.* 2018). Jackfruit constitutes three parts viz., bulb (30-32%), seeds (18%) and the rind (5-55%) of the ripe fruit. The primary economic product of jackfruit is the fruit, used both when immature and when occur during the peak season.

The Jackfruit is a multi-purpose species providing food mature. The fresh de-seeded sweet pulp of the fruit are consumed as such by people and cannot be stored for long time due to its perishability as a result huge post-harvest losses (30-35%), timber, fuel, fodder, and medicinal and industrial products. The primary economic product of Jackfruit is the fruit which is used both when mature and unripe. Every part of the fruit and tree has health and economic value. Jackfruit seeds (nuts) can be roasted like chestnuts, or boiled. Additionally, Jackfruit leaves, bark, inflorescence, seeds and latex are used in traditional medicines. The wood of the tree is also used for various purposes. It is a nutritious fruit that is rich in carbohydrates, proteins, potassium, calcium, iron, and vitamin A, B, and C. Due to high levels of carbohydrates; jackfruit supplements other staple foods in times of scarcity in some regions. The flesh of the jackfruit is starchy and fibrous, and is a source of dietary fibre.

The fruit pulp is sweet and tasty and used as dessert or preserved in syrup. The fruits and seeds are also processed in a variety of ways for food and other products. Jackfruit value added products include chips, papads, pickles, icecream, jelly, sweets, beverages like squash, nectar, wine and preserved flakes etc.

VALUE ADDED PRODUCTS FROM JACKFRUIT

Jackfruit Leather: Bulbs of ripe fruits are selected, cleaned and made into a fine pulp. The pulp is then transferred into a tray to form a thin layer. It is then dried to form a sheet. This process is repeated until the desired number of layers is obtained. After complete drying, it is separated from the tray and cut to pieces or can be rolled (Thomas and Dharmapalan, 2020).Jackfruit leather is made from dried sheets of fruit pulp. It has a soft, rubbery texture, and a sweet taste. It can be eaten as a snack food by adding other fruits, sugar, chopped nuts, or spices to vary the flavour. It can also be used as an ingredient in cookies, cakes, and ice cream (Gunasena*et al.*and Swami *et al.* 2012).

Jackfruit Preserve: Ukkuru and Pandey (2005) standardized jackfruit preserve from fully ripe Varikka jackfruit bulbs, which were found to be nutritionally rich organoleptically sound, shelf stable with excellent consumer appeal.

Jackfruit Ready to serve:Singh *et al.* (2001) has formulated ready-to-serve beverages from jackfruit pulp with 10% pulp content, 12% TSS and 0.3% acidity.

Jackfruit Muffins: It is also a baked product prepared by blending all-purpose flour, sugar, egg, fat, milk, jackfruit pulp, and baking powder. Jackfruit preserve and cake jeera can also be included in the recipe for decorative and flavouring purpose. Method of preparation is almost similar to cake. After the proper beating, the batter is transferred into muffin pans and bake in a preheated.

Jackfruit Based sweets: Various sweet delicacies such as jackfruit halwa (varatty), pudding, jackfruit toffee, jackfruit burfi, elayappam, adda, muffin and payasam, *etc*. could also be prepared from jackfruit bulbs (KAU, 1999)

JackfruitReady to eat (RTE) products: Ripe jackfruit bulbs can also be preserved with minimal processing into ready to eat convenience food product. But this product has a limited shelf-life and has to be stored and transported under refrigeratedconditions (Srivastava *et al.* 2017).

Jackfruit Bulb powder: Osmosis of Jackfruit bulbs at 70°B sugar solution and dried at 60°C in tray dryer were most suitable for the preparation of jackfruit bulb powder. Jackfruit bulb powder stored at met pet poly pack revealed good results with respect to chemical and sensory quality during 12 months of storage period (Swami *et al*. 2016).

Jackfruit Candy: For candy preparation half-ripe jackfruit (medium hard flesh) is selected and washed. Then it is cut into 1x 0.5x 0.5 cm pieces and blanched in hot water at 95°C for 4 minutes. After that the pieces are immersed in 2 per cent calcium lactate and 0.1 per cent KMS for 2 hours and drained. The pieces are then dipped into sugar solution of 25, 35, 45, 50, 60 and 70 ^{0}Brix at 12 hours interval. The slices are drained and washed with clean water to remove adhering syrup followed by drying at 70°C in a cabinet dryer until the moisture content reaches to 10 per cent. The product is packed in polypropylene pouch and stored at room temperature (28-32°C) (Bhuyan*et al*., 2013).

JackfruitJam: Jam is prepared from the pulp of ripe fruits with additives. Bulbs from a fully ripe jackfruit are blended and boiled for 5-7 minutes to extract juice. Then 700g sugar and 10g pectin is added to 1kg jackfruit pulp and cooked until the TSS reaches to 64 °Brix, then citric acid (0.25%) is added. End point is determined through flake test and the jam is poured while hot in sterilized bottle and stored at room temperature (Bhuyan*et al*., 2013).

JackfruitPickle: Unripe jackfruits are used for preparing pickle. Small pieces are made from bulbs and seeds and they are mixed with oil, salt and spices before packing.

Jackfruit Papad: Ukkuru and Pandey (2005) standardized jackfruit papads of different taste and flavour from raw jackfruit which were very crispy and tasty when fried.

JackfruitChips: Raw or unripe jackfruits are used for preparing chips. Slices of suitable sizes are cut and blanched into hot water at 95°C for 5 minutes. Then the slices are dried at 60°C for 1 hour and 70°C for next 6 hours. Finally the slices are fried at 160°C in edible oil. The slices are removed from the pan when they turn light yellow in colour and mixed with salt and packed (Bhuyan*et al.,* 2013). The nutrients in jackfruit will remain same and also it retains its own original colour, flavour and texture after frying. The jackfruit chips are rich in vitamin E, y-oryzanol and phytosterols which provide health benefits (Molla*et al*., 2008).

Jack fruit Halwa: Deseeded bulbs extracted from jackfruit weighing 1kg is steamed and blanched in a cooker for about 10 min till it becomes soft. Blanched bulbs are made into the form of a pulp and homogenized using a blender. Thick coconut milk (500ml) is added to Jaggery (750 g) and made into the form of syrup by boiling and straining. Virgin coconut oil(120 ml) is added to a pan and heated. When oil is hot, blanched pulp and jaggery/coconut milk syrup added to it. The contents (pulp and syrup) were fried in virgin coconut oil with constant stirring for about one hour till the mixture thickens and become semi solid. Stir continuously and add jack seed flour at various levels, *viz*. 0% (control), 5%, 10% and 15% cook for another 30 minutes. At this point, the mixture will attain a semisolid consistency. Add these main ingredients like cardamom powder, fried coconut pieces, cashewnut pieces and stir it continuously till it becomes thick or halwa consistency. Allow the mixture to cool and when it becomes solid, can be cut into shapes, weighed and packed (Satheeshan, 2019).

CONCLUSION

Jackfruit is a tropical tree, which is a rich source of nutrients such as carbohydrates, proteins, vitamins, minerals, dietary fibre and phytochemicals. The value added products from jackfruit can play an important role in the economic development of the farming community. Jackfruit offers exciting possibilities for adding novel products to the food processing industry and contributes towards enhancing the farm income of rural people. Technologies to ensure availability of

the fruit throughout the year and avoiding wastage should be promoted for this wonderful fruit.

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GROWTH AND INSTABILITY IN MAIZE PRODUCTION AND EXPORT IN INDIA

Rekha Rani*[1,2], P. K. Singh*[1], Harshita Tewari[3], Priyanka Agarwal[4]

[1] Department of Agricultural Economics, Institute of Agricultural Sciences, BHU, Varansai, Uttar Pradesh

[2] Present Address: ICAR-Central Institute for Arid Horticulture, Bikaner, Rajasthan

[3] Department of Agricultural Economics, Ch. Chhotu Ram (P.G.) College, Muzaffarnagar, Uttar Pradesh

[4] ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi

*Corresponding Author e mail: rekhatamta10@gmail.com and pksbhu222@gmail.com

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ABSTRACT

Maize (*Zea mays*) is one of the most important cereal crops of the world and contributes to food and nutritional security in most of the developing countries. Globally, maize is known as queen of cereals because of its several uses and highest genetic yield potential among the cereals (Parihar *et al.,* 2011). The crop is of utmost importance as it has versatile uses as human and animal feed along with industrial uses. The crop at the same time opens the door of opportunities for crop diversification, value addition and employment generation. The traditional and modern industrial uses have made it one of the fastest growing cash crops in the world (Kumar *et al.* 2013).Considering its global as well as national importance, present study is conducted to analyze the growth performance of maize area, production and productivity in India for past fifty years (1966-67 to 2015-16) and export for twenty two years (1993-94 to 2014-15) by using compound annual growth rate (CAGR). Growth without stability is an incomplete story. So the instability index was also determined by using Cuddy Della Valle index. To compare the different scenario, the entire study period was divided into five equal sub periods in case of area, production and productivity and into two sub periods in case of export. Overall, the positive growth rate was observed in the area, production and productivity of maize but with a significant instability. The decadal comparison of maize production concluded that it was after 1990s when the crop has started performing well in all the three parameters. The period - IV and V was found to be the best performing periods with positive growth rate and low instability index. The same period was found to be excellent for maize export scenario.

Key words: *CAGR, maize, export, instability, cuddy della valle index*

INTRODUCTION

After rice and wheat, maize is the third largest produced and consumed food crop in India. It directly contributes almost 10 percent to the Indian food basket and 5 percent to the world dietary energy supply (Kumar *et al.* 2013). It is mainly a kharif season crop in India but grown in all the three seasons including rabi and zaid. In some of the regions, spring maize (February–April/May) is also becoming popular with short-duration varieties (<100 days). The major maize producing states during the kharif season are Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh, Uttar Pradesh, etc. The Rabi maize producing states are Bihar, Uttar Pradesh, Punjab and coastal region of Andhra Pradesh, Karnataka etc (Maize Special Report, June 2016).

The diverse application of maize has lead to increase in its demand domestically as well as internationally. About 64 percent of the total maize production is used for poultry feed, followed by 19 percent for industrial starch and beverage, 16 percent for human consumption and 1 percent for seed (India Maize Summit, 2014). Keeping in view the recent interest of urban consumers especially in specialty corn like sweet corn, baby corn and popcorn etc. it is expected that demand for maize as food may rise to 2.0 MT by 2025 (India Can Achieve, 2016).

The data released by Govt. of India indicated ever-highest maize production in the history of India during 2016-17 till the year amounting 25.90 million tons even after following two consecutive drought years (Agricultural Statistics at a Glance, 2018).Despite of drought-like conditions in 2014-15 and 2015-16, the maize area has increased in Gujarat, Himachal Pradesh, Jharkhand, and west Bengal. In addition, the maize production has increased in Bihar, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Tamil Nadu and West Bengal whereas, maize productivity has been increased in Bihar, Jammu & Kashmir, Madhya Pradesh, Tamil Nadu, Uttar Pradesh and West Bengal (Mahajan, 2017). The third advance estimates released by the Department of Agriculture, Cooperation and Farmers Welfare, GOI, revealed 28.98 million tons of maize production in 2019-20. India shows a picture of a tremendous growth since 1950-51 when it was only 1.73 million tons.

Maize has diversified industrial application which resulted into increase in its demand globally over the years. Maize currently accounts for 22 percent of total cereal exports from the country.India's key export destinations are South-East Asian countries like Indonesia, Vietnam, Taiwan and Malaysia where 85-90 percent of total maize export is exported (Yadav *et al.* 2016). The maize export gain its momentum since 2007-08 when it witnessed a huge jump that is 27.28 lakh tons from the previous year when it was only 6.37 lakh tons. After that the export volume varies between 26.33 to 47.88 lakh tons till 2014-15. The increase in export volumes is a result of increased production, higher realization and demand for maize from international markets. But, again the export figures showed a sudden downfall to 6.98 lakh tons in 2015-16 (indiastat.com). It has fallen to a ten-year low due to high domestic prices caused by a shortfall in production as well as lower international prices. The situation turned worse toward the end of the fiscal year, with the country had to import maize (Gummula, 2016).

Increase in growth of different parameters of maize portrays only the half picture of overall performance. Growth is always accompanied by the instability which must be studied simultaneously. Instability in production is a major factor in causing

price volatility which in turn has serious implications for food management, food security and economic stability of a country. Keeping this background in view, present study is conducted to analyze the growth rate and instability in area, production, productivity and export of maize in India.

MATERIALS AND METHODS

The data of fifty years was used i.e. from onset of green revolution, 1966-67 to 2015-16. The entire period was further divided into following five equal sub periods viz; Period - I: 1966-67 to 1975-76, Period - II: 1976-77 to 1985-86, Period - III: 1986-87 to 1995-96,Period - IV: 1996-97 to 2005-06,Period - V: 2006-07 to 2015-16. The data on area, production, productivity and export of maize in India was collected from www.indiastat.com and apeda.gov.in. The maize export (quantity and value) performance was investigated for the period of twenty two years i.e. from 1993-94 to 2014-15, as per the availability of data. The year 2015-16 and 2016-17 was not included in the study as the years were found to be abnormal. The period was further bifurcated into two sub periods viz; 1993-94 to 2002-03 and 2003-04 to 2014-15.

To examine the growth rate and instability in different variables Compound Annual Growth Rate (CAGR) and Cuddy Della Valle index was used, respectively (Ramdas et al. 2012; Mokashi and Hosamani, 2014; Ali and Jabbar, 2015; Deb and Pramanik, 2015; Seidu and Kundu, 2018)

Compound Annual Growth Rate

Compound annual growth rate (CAGR) is an average growth rate over a period of several years. It was employed by fitting exponential growth function of the following form:

$Y_t = ab^t$

Where, Y_t is dependent variable, a is intercept, b is regression coefficient and t is time variable (1,2,…..,n). The compound growth rate was obtained from the logarithmic form of the equation as below:

$\ln Y = \ln a + t \ln b$

The percent compound annual growth rate (r) was derived using the relationship:

$r = (\text{Anti log of } (b) - 1) * 100$

Cuddy-Della Valle Index

The index was originally developed by John Cuddy and Della Valle for measuring the instability in time series data (Cuddy and Della, 1978). A low value of this index indicates the low instability in farm production and vice-versa. The instability index is expressed as:

$\text{Instability Index} = CV * (1-R^2)^{1/2}$

Where, $CV = (\sigma / \mu) * 100$

σ = Standard deviation of variable

μ = Mean value of the variable

RESULTS AND DISCUSSION

Growth rate in area, production and productivity of maize

Growth rate in area, production and productivity of maize was analyzed by fitting exponential function and compound annual growth rates were then estimated for entire fifty years as well as for all the sub periods. The results are presented in table 1. The table shows that in sub period - I the area increased with a significant growth rate of 1.31 percent whereas, production and productivity showed positive but insignificant growth rate. The sub period - II was showing the negative and insignificant growth rate in area but positive and significant growth rate in production and productivity. In the sub period - III, all the three variables showed a positive and significant values with highest growth in productivity i.e. 3.15 percent during entire study period. The table further unveils that, it was sub period - IV which recorded highest and significant growth rate in area i.e. 2.33 percent

Table - 1 : Compound annual growth rates (CAGR) of area, p roduction and productivity of maize in India (CAGR in percent)

Particulars		Period - I (1966-67 to 1975-76)	Period - II (1976-77 to 1985-86)	Period - III (1986-87 to 1995-96)	Period - IV (1996-97 to 2005-06)	Period - V (2006-07 to 2015-16)	Overall (1966-67 to 2015-16)
Area (m ha)	A(S)	5.074	6.00	5.923	6.260	7.894	5.074
	A(E)	6.031	5.797	5.979	7.588	8.806	8.806
	R^2	0.603	0.007	0.403	0.861	0.864	0.757
	Log b	0.013*	-0.001	0.005**	0.023*	0.015*	0.009*
	CAGR	**1.31***	**-0.1**	**0.50****	**2.33***	**1.51***	**0.90***
Production (m t)	P(S)	4.894	6.361	7.593	10.770	15.097	4.894
	P(E)	7.256	6.643	9.534	14.709	22.567	22.567
	R^2	0.135	0.443	0.419	0.750	0.713	0.899
	Log b	0.017	0.027**	0.036**	0.037*	0.044*	0.031*
	CAGR	**1.71**	**2.74****	**3.67****	**3.77***	**4.50***	**3.15***
Productivity (q/ha)	Y(S)	9.65	10.60	12.82	17.20	19.12	9.65
	Y(E)	12.03	11.46	15.95	19.38	25.63	25.63
	R^2	0.011	0.504	0.394	0.415	0.577	0.902
	Log b	0.004	0.028**	0.031***	0.014**	0.028**	0.021*
	CAGR	**0.40**	**2.84****	**3.15*****	**1.41****	**2.84****	**2.12***

Note: S: Starting year of the period, E: End year of the period
*, ** and *** indicates level of significance at 1, 5 and 10 percent respectively.

during entire study period. The fifth sub period witnessed highest growth rate of 4.50 percent in production over entire study period. Also, area and productivity was positive and significant in same sub period. Table further reveals that overall maize area on an average increased at a rate of 0.90 percent whereas, production and productivity increased at greater rate i.e. 3.15 and 2.12 percent per annum, respectively. The production has increased more than four times in 2015-16 as compared to 1966-67. Also, the productivity becomes more than double as showed a significant increase from 9.65 q/ha in 1966-67 to 25.63 q/ha in 2015-16. The high value of R^2 depicted that the fitted model very well explains the variations in maize area, production and productivity over the entire study period.

Instability in area, production and productivity of maize in India

Instability in area, production and productivity of maize was measured by using Cuddy- Della Valle index and the results are presented in table 2.

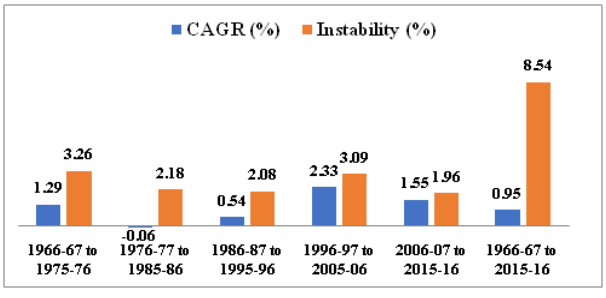
Table - 2 : Instability in area, production and productivity of maize in India

Particulars		Period - I (1966-67 to 1975-76)	Period - II (1976-77 to 1985-86)	Period - III (1986-87 to 1995-96)	Period - IV (1996-97 to 2005-06)	Period -V (2006-07 to 2015-16)	Overall (1966-67 to 2015-16)
A (mt)	**Mean**	5.75	5.83	5.91	6.74	8.55	6.56
	CV (%)	4.87	2.06	2.54	7.72	5.03	17.07
	I (%)	**3.26**	**2.18**	**2.08**	**3.09**	**1.96**	**8.54**
P (mt)	**Mean**	6.01	6.75	8.61	12.45	20.72	10.91
	CV (%)	14.14	12.74	15.21	13.33	14.77	52.24
	I (%)	**13.86**	**10.06**	**12.32**	**7.06**	**8.42**	**16.72**
Y (q/ha)	**Mean**	10.44	11.59	14.54	18.41	24.13	15.82
	CV (%)	11.88	12.42	13.69	6.79	10.61	33.63
	I (%)	**12.47**	**9.32**	**11.23**	**5.50**	**7.32**	**10.76**

Note: A: Area, P: Production and Y: Productivity, CV: Coefficient of variation, I: Instability Index

The sub period - I recorded highest instability of 3.26 percent in area. The subsequent sub periods witnessed a reduction in instability and least i.e. 1.96 percent was observed in sub period-V. Overall study period recorded the instability index of 8.54 percent. The study further compared the maize performance in area under cultivation in different sub periods on the basis of combined results of CAGR and instability index. The results are presented in figure 1. Figure shows that it was the period - IV (1996-97 to 2005-06) and V (2006-07 to 2015-16) which performed better than other sub periods as the gap between instability and CAGR was low.

Figure 1: CAGR and instability in maize area in India



Further, table 2 reveals that the mean maize production showed an increasing trend with less variability in the data as the coefficient of variation (CV) is around 12-15 percent in different sub periods. The instability index reflected fluctuation over the decades. It was highest in the sub period - I (13.86 %) and least in sub period – IV (7.06 %). Maize production in India during entire fifty years revealed 16.72 percent instability which was greater than that prevailed in all the sub periods. The combined results of CAGR and instability index are presented in figure 2. The figure shows that in period - I, II, and III, instability was much greater than the CAGR offsetting the maize performance during these periods. It was period - IV and V which were found to be most stable with positive and significant growth rate.

Figure 2: CAGR and instability in maize production in India

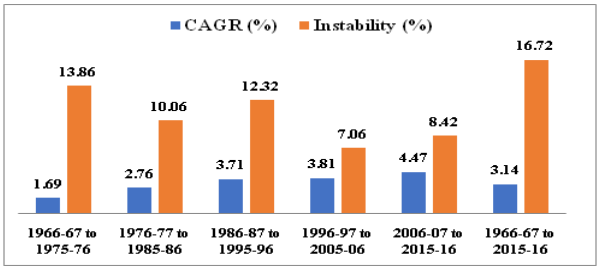
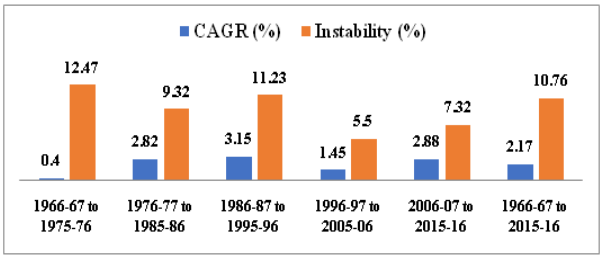


Table 2 further unveils that the mean productivity increased over the decades and the CV showed its lowest value in period - IV which depicted the lowest dispersion of data in this period. Further, it can be seen from the table that the instability in productivity showed somewhat similar trend as that of production. Just like production, the instability was highest in sub period I and lowest in sub period IV. Table further unveils that the decade (1996-96 to 2005-06) was most stable in both maize production and productivity. The table at last shows the instability in productivity for entire study period and was 10.76 percent. The sub period - I can be declared as the least stable decade as the instability was highest for all the parameters viz; area, production and productivity. Figure 3 further summarized the CAGR and instability results of Maize productivity in India. The figure shows the similar pattern as shown by maize area and production. It was again period - IV and V which showed more stability along with highest positive and significant growth rate compared to other periods.

Figure 3: CAGR and Instability in Maize Productivity in India



and value of maize

The growth rate in export quantity and value of maize was analyzed and are presented in table 3. The perusal of table reveals that in sub period - I although, the export quantity increased but the registered growth rate was not found to be significant. Similarly, in the same period export value exhibited the same results.

Table - 3 : Compound annual growth rates (CAGR) in quantity and value of maize export from India (CAGR in percent)

	Quantity (000 tons)			Value (Rs. Crore)		
	Period - I (1993-94 to 2002-03)	Period - II (2003-04 to 2014-15)	Total (1993-94 to 2014-15)	Period - I (1993-94 to 2002-03)	Period - II (2003-04 to 2014-15)	Total (1993-94 to 2014-15)
E(S)	26.67	543.27	26.67	965.87	35445.19	965.87
E (E)	78.18	2825.61	2825.61	6773.74	403750.8	403750.8
R^2	0.02	0.66	0.74	0.19	0.79	0.85
Log b	0.08	0.20	0.37	0.20	0.28	0.41
CAGR	8.33	22.14*	44.77*	22.14	32.31*	50.68*

*, ** and *** indicates level of significance at 1, 5 and 10 percent respectively.

E(S): export quantity/value in the starting year of period; E (E): export quantity/value in the end year of period

The sub period II showed more than two times increase in the growth rate of export quantity from last decade. The decade recorded a CAGR of 22.14 percent at 1 percent level of significance. In the same period, the similar increasing trend was observed in case of export value of maize. The high R^2 value indicates that the 79 percent variation in the export value of maize was very well explained by the fitted model. The results were consistent with the findings observed in various studies. According to India Maize Summit 2014, India has witnessed a jump in maize exports from 2007-08 and became a net maize exporter since the same year. Table further shows that both maize export quantity and value increased at 45 percent and 51 percent respectively during the entire period i.e. from 1993-94 to 2014-15.

Further, the study examined the instability index in both maize export quantity as well as value. The results are presented in table 4. The perusal of table reveals that the sub period - I recorded the highest instability as well as insignificant growth rate in both export quantity and value. Further, in sub period - II the export showed less variation as the instability index was 0.34 percent only. The export value in the same decade unveiled the similar results.

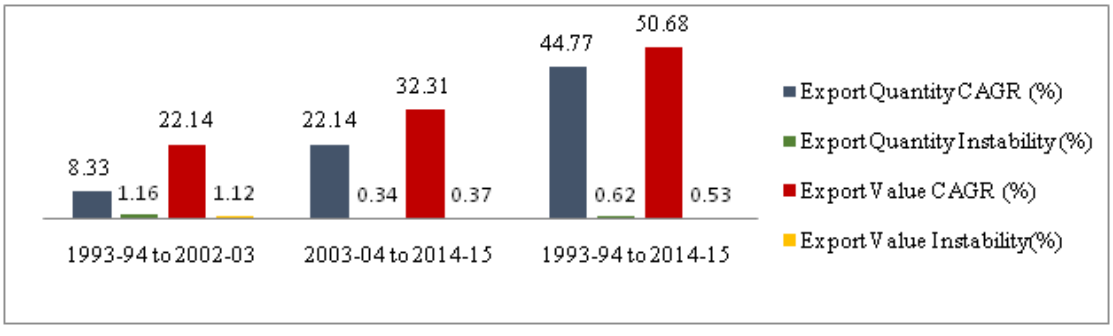
Table - 4 : Instability in quantity and value of maize export from India

	Quantity (000 tons)			Value (Rs. Crore)		
	Period - I (1993-94 to 2002-03)	Period - II (2003-04 to 2014-15)	Total (1993-94 to 2014-15)	Period - I (1993-94 to 2002-03)	Period - II (2003-04 to 2014-15)	Total (1993-94 to 2014-15)
Mean	34.88	2501.26	1380.18	2605.57	299132.6	164347.6
CV (%)	1.06	0.59	1.20	1.18	0.77	1.36
I (%)	1.16	0.34	0.62	1.12	0.37	0.53

CV: Coefficient of variation; I: Instability index

On an average, during the entire study period i.e. from 1993-94 to 2014-15, India performed well in exporting maize as instability index was not too high. It was 0.62 and 0.53 percent only for export quantity and value respectively. The overall analysis of growth rate and instability in export quantity and value was summarized in figure 4. The figure shows the maize export performed very well in the study period as the higher value of growth rates were accompanied by very small instability for both quantity and value. This can be explained by increased production, rise in international demand because of its industrial use and economic reforms (liberalization) in the country.

Figure 4: CAGR and instability in export quantity and value of maize in India



CONCLUSION

Present study was conducted to examine the growth and instability in area, production, productivity and export of maize in India. Compound Annual Growth Rate (CAGR) and Cuddy Della Valle Index were used to analyze the growth rate and instability, respectively. The overall analysis of growth rate and instability of maize area, production and productivity concluded that it was the year 1996-97, after which maize recorded highest growth rate in all the three parameters with less instability. Thus, period - IV and V can be declared as the best performing periods for area, production and productivity during entire period of fifty years. This must have pave the way for good performance of maize export as the period 1993-94 to 2014-15 witnessed a positive growth rate with very less instability.The findings of the study are consistent with the prediction of Paroda and Kumar (2000) and the results of study conducted by Joshi *et al.* (2005) and Kumar *et al.* (2013). The growth in maize area since 1990s might be due to a seasonal and regional shift in maize cultivation whereas increased production might be the results of expanded area and adoption of single cross hybrids. Further, off season (Rabi) cultivation practices showed the comparative advantage of high productivity, low insect pest and disease infestation along with slow growth of weeds which resulted into higher productivity.

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BIOLOGICAL CONTROL (TRICHODERMA SPP. AND A-MYCORRIHZA) AGAINST VASCULAR WILT CAUSED BY F. OXYSPORUM F. SP. CICERIS INFECTING CHICKPEA.

Mehjabi Hashmi[1], Rajesh Kumar Pandey[2] and Shahnashi Hashmi[3]

Department of Plant Pathology, Sardar Vallabh Bhai Patel University of A & T, Meerut[1], (U.P.), India

Botany department Bundelkhand University, Jhansi[2], (U.P.), India

Institute of Agriculture science Bundelkhand University, Jhansi.[3] , (U.P.), India

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ABSTRACT

Chickpea (*Cicer arietinum* L.) is a vital source of plant derived edible protein in many countries. Chickpea also has advantages in the management of soil fertility, particularly in dry lands and the semiarid tropics. Chickpea (*Cicer arietinum* L.) is the world's third most important pulse crop, after dry beans (*Phaseolus vulgaris* L.) and dry peas (*Pisum sativum* L.). Chickpea are affected of many diseases such as Ascochyta blight, Powdery Mildew, White Mold Stem and Crown Rot etc. Among these disease wilt is the major disease of chick pea caused by *Fusarium oxysporum* f. sp. *Ciceris*, reduced the production and quality of this crop. Consistent and indiscriminate uses of toxic and deadly killer chemical fungicide in soil is known to destroy biodiversity of pathogens as well as beneficial soil microflora. Biological control is the important practice for wilt disease management and reduce the environmental pollution. Used of different biological agents such as A. Mycorrhizae viz. *Acaulospora scro-bioculata*, *Glomus intrardeces*along with different strain of *Trichoderma* spp. provide high rate of protection against *Fusarium oxysporum* f. sp. *Ciceris* and also released secondary metabolites and supplying valuable nutritive material. *Acaulospora scrobioculata* and *Glomus intrardeces* are not only known to suppress the harmful micro-flora it is also making plant more tolerant by supplying a wide range of macro and micronutrient to plants from the soil. In addition, the due to the nature of competition, *Trichoderma* is favoured and multiplied on dead mycelium of host pathogen *F. oxysporum* f. sp. *ciceri*. The present findings are also supported by the results of other workers that the fungal and *Acaulospora scrobioculata* and *Glomus intrardeces* provided significantly higher disease control in several crops than that obtained by either any one alone, These treatments could be important components of organic forming for chickpea. The present study has demonstrated that the integration of *T. harzianum*, *T. viride*, *T. virens*, with *Acaulospora scrobioculata* and *Glomus intrardeces* can be used for not only the managing wilt disease and disease complexes of chickpea also would be essential ingredients for sustainable quality organic farming.

Keywords : Fusarium, oxysporum, biological control, chickpea

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the world's third most important pulse crop, after dry beans (*Phaseolus vulgaris* L.) and dry peas (*Pisum sativum* L.) – (Vishwadhar and Gurha, 1998). Chickpea (*Cicer arietinum* L.) is a vital source of plant derived edible protein in many countries. Chickpea also has advantages in the management of soil fertility, particularly in dry lands and the semiarid tropics. Indian subcontinent accounts for 90% of the total world chickpea production (Juan et al., 2000). *Fusarium oxysporum* f. sp. *ciceris* is a wilt fungus causing severe damage wherever this crop is grown (Rangaswami et al., 1999). *Fusarium* wilt is one of the major diseases of chickpea and at national level the yield losses encountered was reported to the tune of 60 per cent (Singh et al., 2007).). It causes complete loss in grain yield if the disease occurs in the vegetative and reproductive stages of the crop (Haware and Nene, 1980; Haware et al., 1990; Halila and Strange, 1996; Navas et al., 2000). *F. oxysporum* f. sp. *ciceris* infects chickpea at seedling as well as at flowering and pod forming stage (Grewal, 1969), with more incidence at flowering and podding stage if the crop is subjected to sudden temperature rise and water stress (Chaudhry et al., 2007).

The pathogen is mainly soil borne as well as seed borne and also it is a facultative saprophyte. It can survive in the soil upto six years in the absence of susceptible host (Haware et al., 1978).The disease occurs at seedling and flowering stage of plant growth. The symptoms which can be observed are drooping of petioles and rachis, yellowing and drying of leaves from base to upward, browning of vascular bundles, improper branching, withering of plants and finally death of plants (Westerlund et al., 1974; Prasad and Padwick, et al., 1939). Saxena and Singh (1987) reported that internal discoloration of pith and xylem can be seen if stem and root of the wilted plants split vertically. Kaur (2003) studied on control of *Fusarium oxysporum* f. sp.*ciceris* by non-pathogenic *Fusarium* and *fluorescent pseudomonads* in growth chambers and in micro plots and the selected isolates of non-pathogenic *Fusarium* and *fluorescent pseudomonads* were evaluated singly as well as in combination against *Fusarium oxysporum* f. sp. *ciceris* causing chickpea wilt and found that the combination of Fo52 with C7R12 was the best where none of the plants showed disease at 30 days after sowing and only 10 per cent plants showed wilting after 60 days. Seed treatment with *T. harzianum* mutant UM2R + carbendazim (1.25 g kg-1) resulted in the maximum seed yield (4.6 g plant-1) and lowest disease incidence (2.5%) as reported by Poddar et al. (2004). Sharma et al. (2005) reported that the combination of neem cake + carbendazim + *T. harzianum* provided the highest control of the disease *Fusarium* yellows caused by *Fusarium oxysporum* f. sp. *gladioli.* Raju (2005) reported that the lowest disease (pigeon pea wilt) incidence (6.6%), and the highest number of nodule per plant (23.3), fresh weight per plant (6.3 g), and dry weight per plant (2.2 g) were obtained with *T. viride* + carbendazim. Kapoor et al. (2006) found that amendment with Lantana camara (10 t ha1) + bioagent Tricoguard at 2.5 kg or 62 kg FYM ha-1 + spray with carbendazim at pre flowering stage was most effective in managing the root rot-wilt complex disease in pea.

Nikam et al. (2007) reported that combined soil application of *T. viride* and ground nut cake followed by neem cake had given good control against chickpea wilt caused by *Fusarium oxysporum* f. sp. *ciceris*. Jayasekhar et al. (2008) found that under field conditions soil application of *Pseudomonas fluorescens* Pf (NI) followed by carbendazim spray (0.2%) after 30 days of

Pseudomonas application recorded the lowest disease incidence of 3.77 percent. Singh (2009) reported that the application of two bioagents *viz., Trichoderma harzianum, Pseudomonas fluorescens* and two fungicides carbendazim (0.1%) and mancozeb (0.25%) at 45 DAS was found effective for the control of coriander wilt caused by *Fusarium oxysporum* f. sp. *coriandrii*. Srivastava et al. (2011) found that combined use of *fluorescent pseudomonads, T. harzianum* and Arbuscular mycorrhizal fungus significantly reduced disease incidence and severity by 74 per cent and 67 per cent in pots and field, respectively. Plant root provide an ecological niche for many of microorganisms that abound in soil. German Botanist Frank (1985) introduced the Greek word mycorthiza.These fungi form symbiotic association with most terrestrial plant families (Trappe 1977). In natural ecosystem mycorrhizal fungi can colonize much of the root system. Colonization is restricted to the root cortex and does not enter the vascular cylinder. The symbiosis is so well balanced that, although many of the host cells are invaded by the fungal endophyte, there is no visible tissue damage and under certain condition it enhances the growth and vigour of the host plant. Because most economically important plants agricultural, horticultural and forestry research. Three are different types of mycorrhizae. As the present study was concerned with AM fungi, information available in literature on its benefits, occurrence, taxonomy and culturing techniques was reviewed and is being presented here, in short.

MATERIALS AND METHODS

Development of talc based formulations for *Trichoderma spp* to improve shielf life and delivery system:

The isolates of antagonist, *Trichoderma spp. viz. T.harzianum, T.viride, T.virens* which were tested *in-vitro*, and were now undertaken for *in-vitro* testes in the present investigations. The pathogen and antagonists' fungi were maintained on PDA slants at 5^0C after growing for seven days at 25 ± 2^0C. Sorghum grains were presterilized and overnight soaked in conical flask. The culture of *Trichoderma spp.* was multiplied and inoculated to the conical flasks, and then it was incubated at 25 ± 2^0C for 10 days. Profuse developed mycelium and conidia on sorghum were transferred in sterile bloating paper for air drying under laminar air flow. The dried colonized sorghum grains were powdered under aseptic conditions. The concentration of conidia and chlamydospores were further determined using a haemocytometer prior to preparation of formulation.

Determination of colony forming unit (CFU) in powdered *Trichoderma spp.* mycelium by Haemocytometer:

The haemocytometer has a central area which is slightly lower (0.1 mm) than the rest of surface of the slide. This depression froms the counting area/chamber. Finely ruled areas can be seen at the surface of the slide that forms grids. The height between the slide and the base of the depression of the counting area measured from the grid defines a known volume. By counting the cells or spores in this volume, the no. of cells oespores per unit volume can be calculated and this value indicates the cfu or spores/ml in the original volume.

Dilution of formulation, haemocytometer, compound microscope, cover slip, micropipette with disposable tips.

Procedure

- Clean the heemocytometer and cover slip in distilled water and wipe them with alchol.
- After drying, place the moistened (with water or exhaled breath) cover slip in position so that it is centred over the counting chamber.
- Suck up a small amount of the formulation

suspension/solution to be counted in a final tipped micropipette. Gently touch the tip against the side of the cover slip where it touches the base of the depression. A drop of suspension should be drawn out of the pipette into the chamber.

- Place the haemocytometer under a microscope. Trun the microscope on and under low/high power, focus on the grid area of the counting chamber.
- Under the microscope the grids area can be seen to be formed of 9 large squares in 3x3 grid. Each of these squares covers an area of 1 mm^2 which, with the depth of the chamber being 0.1 mm, means that the volume of each large square is 0.1 mm^3.
- The central area of the grid is made up triple ruled lines that in the centre form a 5x5 grid of 25 squares with a total volume of 0.1 mm^3. each one of these 25 squares is futher divided up into 16 smaller ones in a 4x4 grid.
- While counting high densites of spore suspension, use the 40x objective and count the four corners and one centre square of 4x4 grid. When counting, scan from the top left and move to the bottom right.
- spores falling on the bordering triple lines should only be counted if they are on either the top or on the left lines only. Exclude touching the bottom and the right hand side lines. The most accurate count is achieved whene 40-70 cells or sporscan be counted in 4x4 grid. If no. of cells or spores are more than this, then sample should be diluted and recounted. If no. of spore are less than this, use either the low density cell population method as described below or centrifuge and re-suspend the spores in a smaller volume.

If no. of spore counted in 5 squares of 4x4 grid = X

- No. of spores/ml suspension = $\frac{X \times 25 \times 10^4}{5}$

$= X \times 5 \times 10^4$

- In case a dilution is applied, the concentration should be divided by the dilution applied.
- In this case the formula will be-
- No. of spores/ml suspension= $\frac{X \times 5 \times 10^4}{\text{Dilution used}}$
- Example: for a 1:10 dilution

dilution=0.1 or 10^{-1}

- For a 1:100 dilution

dilution=0.01 or 10^{-2}

- When counting a low density spore suspension, use 10x objective lens and count the squares (0.1 mm^3) in each corner of the 3x3 grid, i.e. outside the triple ruled area. Divide the number of spore counted by 4 and multiply by $10^4$to get the number of spore per ml.
- To visualize and counting of viable (live) cells or spore, trypan blue is used. Mix equal volumes of fresh and filtered 0.4% trypan blue stain in phosphate buffer saline and a well mixed cell suspension e.g. mix 100µl trypan blue with 100µl spore suspension. Pipette out trypan blue/spore suspension (approximately 10µ) at the edge of the cover slip and allow to run the cover slip. Visualize the haemocytometer grd under the microscope. Trypan blue is a vital stain; it is excluded from live cells so live cells appear coloureless and bright (refractile) under phase contrast. Dead cells stain blue and are non-refrctile.
- Calculation of cell viability-
- % viable cells= $\frac{\text{no. of vible cells counted} \times 100}{\text{Total cells counted (viable + dead)}}$
- Although trypan blue may be used for counting of viable spores, yet serial dilution is syill widely used method for viable spore

count.

Mixing of powdered *Trichoderma* spp mycelium in Talc fne powder after spore load determination:

after estimation of spore load in fine power of *trichoderma spp.* and *Fusarium oxysporum* f. sp. *Ciceris* required amount of the same was added in requisite dose to each of the presterilized carrier after ensuring the spore load of each formulation as $2x10^8$CFU/g. the formulation for the present study with their respective constituents were:

- Talc+ *T.harzianum*@1:1
- Talc+ *T.viride*@1:1
- Talc+ *T.virens*@1:1

This was followed by sealing 200g of formulation under a laminar air flow.

Sterilization of Samples:

- The diseased samples (root and shoot of chickpea) were collected and brought from fields of given villages. These samples were sterilized first before the start of the studies and later the samples were cut into various segments of 0.5 cm size approximately. These segments were surface sterilized with 70% ethanol for 5 seconds followed by 4% NaOCl for 90 seconds, the washed in sterilized distilled water for 10 seconds.
- Sterilization is done to destroy or remove all living organism from the surface without damaging or altering the substances being sterilized.
- Cleaning and sterilization of glassware's and minor equipments was done in each case. Borosil and corning's glassware's were used for all the laboratory experimental studies. The glassware's used for the experiment were thoroughly washed with liquid detergent (cedepol) and then sun dried. After sun drying these glassware's were again cleaned by keeping them in chromic acid overnight (Alexopolous and Benek, 1962), after chromic acid treatment they were washed with distilled water to remove chromic acid and again sun dried. After drying, these glassware's were sterilized by keeping them in the oven at 160-180^{o}C for 4-6 hours.
- The small instruments like forceps, needles etc, were ordinarily sterilized by dipping them in 95% alcohol followed by flaming. These instruments were repeatedly sterilized during the operation to avoid contamination. Culture vessels containing the media were plugged with cotton and sealed with aluminium foil and were generally sterilized by heating in an autoclave at 15 PSI (pond per square inch) at 121^{o}C for about 20 minutes.
- Before pouring the culture media or inoculation, the hands are repeatedly sterilized with 75% alcohol to avoid contamination.

Procurement of A-Mycorrihza:

For *in-vivo* experiment, A-Mycorrihzal species were procured from Division of Plant Pathology, Cenral Agroforestry Research Institute (CAFRI) Jhansi-.284001 Two genus of A-mycorrihza viz. a. *Acaulospora scrobioculata, b. Glomus intrardeces.*

***In-vivo* biological management of vascular wilt infecting chickpea:**

Details of the layout of micropot in experimental layout were as under:

- Gross pot size - 36 x 24 cm
- Net pot no. - 42
- Replications NO. - 3
- No. of treatment - 14
- Weight of soil in one pot - 7-8 kg

- Crop variety - chickpea (Jaki 10-9218)
- Date of sowing - 29 Nov 2015
- Date of harvest - Up to 12 March 2016
- Collection of seed - Kendriya Beej Bhandar,Jhansi

Pot experiment was conducted in completely randomized design to explore the most potential of individual and integrated mamanent components selected in present investivgation under pot experiments with 14 treatments including adequate control one with three replications of each treatment. Twenty seeds of susceptible cultivar Jaki-10-9218 were sown in 36x24 cm diameter earthen pots which was solarized by 1% mercuric chloride then filled with 7 kg sterilized soil, the soil was solarized for 10 days. The pathogen *F. oxysporum* f spp. *ciceri* were mass multiplied on sorghum grains were mixed in soil of pots @4g/kg soil in each. The soil was incubated one week before transplantation.

The treatments for this experiment were as follows:

- **T-1=***T.harzianum@ 15g/kg+F.oxysporum* f. sp. *ciceris*
- **T-2=***T.viride@ 15g/kg+F.oxysporum* f. sp. *ciceris*
- **T-3=** *T.virens@ 15g/kg+ F.oxysporum* f. sp. *ciceris*
- **T - 4 =** *Acaulospora scrobioculata@15g/kg+Glomus intrardeces@15g/kg+F.oxysporum* f. sp. *ciceris*
- **T-5=** *T.harzianum@ 15g/kg+ Acaulospora scrobioculata@15g/kg +F.oxysporum*f. sp. *ciceris*
- **T-6=** *T.viride@ 15g/kg+ Acaulospora scrobioculata@15g/kg+ F.oxysporum* f. sp. *ciceris*
- **T-7=** *T.virens@ 15g/kg+ Acaulospora scrobioculata@15g/kg+ F.oxysporum* f. sp. *ciceris*
- **T-8=** *T.harzianum@ 15g/kg+ Glomus* intrardeces@15g/kg+F.oxysporum f. sp. ciceris
- T-9=T.viride@ 15g/kg+ Glomus intrardeces@15g/kg+F.oxysporum f. sp. ciceris
- T-10=T.virens@ 15g/kg+Glomus intrardeces@15g/kg+F.oxysporum f. sp. ciceris

T11=T.harzianum@15g/kg+Acaulospora

- scrobioculata@15g/kg+Glomus intrardeces@15g/kg+ F.oxysporum f. sp. ciceris

T12=T.viride@15g/kg+Acaulospora

- scrobioculata@15g/kg+Glomus intrardeces@15g/kg+F. oxysporum f. sp. ciceris

T-13=T.virens@15g/kg+Acaulospora

- scrobioculata@15g/kg + Glomus intrardeces@15g/kg + F.oxysporum f. sp. *ciceris*
- **T-14=***Control+ F.oxysporum* f. sp. *ciceris*
- Wilt incidence and mortality was recorded at 15 days interwal up to maturity of crop plants.
- **Statistical analysis and presentation of Data:**

The data from field observations were analyzed by using Randomized Block Design described by M-STAT software (1978). The data on various parameters were subjected to statistical analysis by adopting appropriate method of analysis of variance as described by Fisher (1958). The data pertaining to weed population recorded at 20, 40, 60 DAS and harvest were subjected to Log (X+1) and

√x + 0.5 transformations as per requirement for statistical analysis. Wherever, variance ratio (calculated 'F' values) was found significant, critical difference (C.D.) values were computed by following formula for making comparisons between the treatments:

$$C.D. = \sqrt{\frac{V_e}{r}} \times \sqrt{2} \times t$$

- where,
- r : The number of replication,
- V_e : mean sum of squares (MSE) and
- t : tabulated value of 't' at 5% level of significance
- The data have been presented in the form of summary tables with mean values of the characters and the C.D. at 5% level of probability. Suitable graphical illustrations of the data have also been given at appropriate places in the text. The analysis of variance tables have been given in appendices.

The skeleton of analysis is given in Table 1.

Table 1 Skeleton of ANOVA for the design of the experiment

S.No.	Source of Variation	D.F.	SS	MSS	F_{Cal}	F_{Tab}
1.	Replication	2				
2.	Treatment	13				
3.	Errors	26		V_e		
	Total	**41**				

RESULT AND DISCUSSION

Effect of Talc based of Trichoderma viride, Trichoderma harzianumand Trichoderma virens used as seed treatment Bio priming Acaulospora scrobioculata, and Glomus intraradices alone as soil treatment and in integration against vascular wilt causing Fusarium oxysporum f. spp. ciceris in pot condition.

Effect on plant height (shoot)

Effect of Talc based of *Trichoderma viride, Trichoderma harzianum* and *Trichoderma virens* and Bio priming *Acaulospora scrobioculata,* and *Glomus intraradices* against vascular wilt causing *Fusarium oxysporum* f. spp. *ciceris* on plant dry weight (root) given in Table 2 .

Maximum plant height (Shoot) were recorded in T-11 (36.00 cm.) and T-12 (36.00 cm.) followed by T-10 (35.66 cm.), T-3 (34.33 cm.), T-2 (34.00 cm), T-4 (34.00 cm.), T-13 (34.00 cm.), T-5 (32.33 cm.) T-6 (32.00 cm.), T-7 (31.00 cm.), T-8 (30.66 cm.) and T-9 (30.00 cm.) which were significant. T-1 (25.66 cm.) was at par with control (23.66 cm.). In present findings the combination of antagonistic fungal biocontrol agents and A-Mycorrihiza showed significantly highest performance in improving plant highest as compared to the other treatments. It may be due to the synergistic effect of *Trichoderma spp* and A-Mycorrihiza (*Acaulospora scrobioculata,* and *Glomus intraradices*) on both improving the growth and immune system of plant and suppressing the pathogens by its toxin and enzymes. In support of present findings, Pandey et al (2005) also obsereved in his studies on management of wilt disease complex caused by root know nematode and *F. oxysporum* f. sp. *ciceris* on chickpea by fungal biocontrol agents and VA-Mycorrihiza.

Effect on plant height (root)

Effect of Talc based of *Trichoderma viride, Trichoderma harzianum* and *Trichoderma virens* and Bio priming *Acaulospora scrobioculata,* and *Glomus intraradices* against vascular wilt causing *Fusarium oxysporum* f. spp. *ciceris* on plant dry weight (root) given in **Table 2.**

All treatment increased plant height significantly. Maximum plant weight (root) were recorded in T-12 (19.00 cm.) and T-13 (19.00 cm.) followed by T-11 (18.00 cm.), T-10 (17.30 cm.), T-4 (15.66 cm.), T-3 (14.66 cm.), T-2 (14.33 cm.), T-5

(13.66 cm.), T-6 (12.66 cm.),T-7(11.00 cm.), T-8 (10.00 cm.), T-9 (9.00 cm.) and T-1 (8.66 cm.) which were at par with control (5.33 cm.). Similar synergistic effect may also provided by fungal biocontrol agents and A-mycorrihiza for combating soil borne malady present in rhizosphere of the root of chickpea. *Trichoderma spp* and A-Mycorrihiza (*Acaulospora scrobioculata,* and *Glomus intraradices*), being a soil inhabiting would be more effect to manage the soil borne disease like wilt pathogen because both are known to release a wide spectrum of toxin and secondary metabolites in rhizosphere of the root zone. Mechanism of mycoparasitism, lysis and antibiosis would be site of rhizosphere in presence of both beneficial and pathogenic one where due to the strong competition root may have great opportunity to develop on great extent.

Effect on plant weight (shoot)

Effect of Talc based of *Trichoderma viride, Trichoderma harzianum* and *Trichoderma virens* and Bio priming *Acaulosporascrobioculata,* and *Glomus intraradices* against vascular wilt causing *Fusarium oxysporum* f. spp. *ciceris* on plant dry weight (shoot) given in **Table 2**.

All treatment increased Dry plant weight (shoot) significantly. Maximum plant weight (shoot) were recorded in T-12 (4.83 gm.) followed by T-11 (4.26 gm), T-10 (4.16 gm.), T-3 (4.13 gm.), T-4 (4.03 gm.), T-5 (3.93 gm.), T-6 (3.80 gm.), T-8 (3.60 gm.), T-2 (3.90 gm.), T-7 (3.7 gm.) T-9 (3.4 gm.) and T-1 (2.33 gm.) with control (0.52 gm.).

Effect on plant dry weight (root):

Effect of Talc based of *Trichoderma viride, Trichoderma harzianum* and *Trichoderma virens* and Bio priming *Acaulospora scrobioculata,* and *Glomus intraradices* against vascular wilt causing *Fusarium oxysporum* f. spp. *ciceris* on plant dry weight (shoot) given in **Table 2**.

All treatment increased Dry plant weight (shoot) significantly. Maximum plant weight (shoot) were recorded in T-12 (4.83 gm.) followed by T-11 (4.26 gm), T-10 (4.16 gm.), T-3 (4.13 gm.), T-4 (4.03 gm.), T-5 (3.93 gm.), T-6 (3.80 gm.), T-8 (3.60 gm.), T-2 (3.90 gm.), T-7 (3.7 gm.) T-9 (3.4 gm.) and T-1 (2.33 gm.) with control (0.52 gm.).

EFFECT ON PLANT DRY WEIGHT (ROOT):

Effect of Talc based of *Trichoderma viride, Trichoderma harzianum* and *Trichoderma virens* and Bio priming *Acaulospora scrobioculata,* and *Glomus intraradices* against vascular wilt causing *Fusarium oxysporum* f. spp. *ciceris* on plant dry weight (root) given in Table 2 .

Maximum plant dry weight (root) were recorded in T-13 (1.90 gm.) followed by T-11 (1.86 gm.), T-12 (1.86 gm.), T-10 (1.66 gm.), T-3 (1.46 gm.), T-4 (1.46 gm.), T-2 (1.33 gm.), T-5 (1.23 gm.), T-6 (1.13 gm.), T-7 (1.03 gm.), T-8 (1.0 gm.), T-9 (0.86 gm.) and T-1 (0.60 gm.) which were significantly higher. T-11 (0.79 gm.) was at par as compared to controlled pots (0.20 gm.).

EFFECT ON NUMBER OF POD:

Effect of Talc based of *Trichoderma viride, Trichoderma harzianum* and *Trichoderma virens* and Bio priming *Acaulospora scrobioculata,* and *Glomus intraradices* against vascular wilt causing *Fusarium oxysporum* f. spp. *ciceris* on number of pod given in **Table 2**.

All treatment increased number of pod significantly. Maximum number of pod were recorded in T-12 (19.00) followed by T-11 (17.66), T-10 (17.66), T-13 (17.00), T-3 (14.66), T-4 (14.66), T-2 (14.00), T-5 (11.66), T-6 (10.66), T-7 (10.00), T-8 (9.33), T-9 (8.66) and T-1 (7.66) with control (4.33).

EFFECT ON YIELD:

Effect of Talc based of *Trichoderma viride, Trichoderma harzianum* and *Trichoderma virens* and Bio priming *Acaulospora scrobioculata,* and

Glomus intraradices against vascular wilt causing *Fusarium oxysporum* f. spp. *ciceris* on yield given in Table 2.

All treatment increased yield significantly. Maximum yield were recorded in T-12 (11.40 gm.) followed by T-13 (10.93 gm.), T-11 (10.60 gm.), T-10 (10.60 gm.), T-3 (8.80 gm.), T-4 (8.80 gm.), T-2 (8.4 gm.), T-5 (7.0 gm.), T-6 (6.4 gm.), T-7 (6.0 gm.), T-8 (5.6 gm.), T-9 (5.2 gm.) and T-1 (4.60 gm.) as compared to controlled pots (0.20 gm.). In support of present findings, the effect of *Bacillus subtilis* and *Trichoderma harzianum* Rifai, in commercial formulations, alone or in mixture, on glucan as soluble protein content, β-1, 3-glucanase enzyme activity and suppression of *Fusarium* wilt disease caused by *Fusarium oxysporum* f. sp. *Ciceri* in Hashem and Pirooz chickpea cultivars under controlled greenhouse condition with aggressive isolate of *F. oxysporum* f. sp. *ciceri* and *B. subtilis*, *T. harzianum* treatments in liquid and seed coating inoculation methods as result disease severity was significantly reduced by *B. subtilis* (Pandey and Goswami 2005), *T. harzianum* and their mixtures (about 40%).

EFFECT ON NUMBER OF NODULATION:

Effect of Talc based of *Trichoderma viride, Trichoderma harzianum* and *Trichoderma virens* and Bio priming *Acaulospora scrobioculata,* and *Glomus intraradices* against vascular wilt causing *Fusarium oxysporum* f. spp. *ciceris* on number of pod given in **Table 2**.

Maximum number of nodule were recorded in T-2 (38.00) followed by T-3 (35.66), T-4 (33.33), T-5 (33.33), T-6 (26.66), T-10 (18.66), T-1 (18.00) and T-11 (17.33) which were significantly higher. T-7 (16.66), T-12 (16.33), T-13 (15.00), T-8 (13.66) and T-9 (10.66) were at par as compared to control (9.00). Haware *et al*. (1978) reported effective control of chickpea wilt with seed treatment of Thiram + Benomyl. Sugha *et al*. (1995) evaluated 12 fungicides against *Fusarium* wilt of chickpea in vitro and in vivo under glass house and field conditions and reported Carbendazim (50 WP and 25 DS) and Thiram alone and in combination as highly effective in inhibiting in vitro mycelial growth of the pathogen and in reducing wilt incidence both under glass house and field conditions.

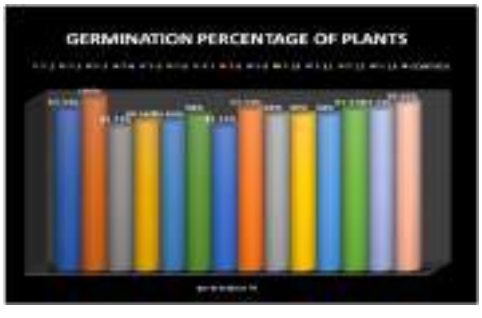
EFFECT ON COLONIZATION INDEX:

Effect of Talc based of *Trichoderma viride, Trichoderma harzianum* and *Trichoderma virens* and Bio priming *Acaulospora scrobioculata,* and *Glomus intraradices* against vascular wilt causing *Fusarium oxysporum* f. spp. *ciceris* on colonization index **Table 2.** Maximum colonization index was recorded in T-2 (26.58) followed by T-9 (18.74) and T-3 (16.52) which were significantly higher. T-7 (13.95), T-13 (13.00), T-12 (12.70), T-1 (11.85), T-10 (10.42) T-8 (8.95) T-11 (8.73), T-6 (8.45), T-4 (7.96) and T-5 (7.16) were at par as compared to control (5.10). The AM fungi associations have been believed to increase the resistance in plants against pathogen *Fusarium oxysporum* f. sp. *ciceri* attack by induced systemic resistance in addition to improved nutritional requirements of plants. The data obtained here may be correlated to the presence of arbuscules in diseased mycorrhizal plants even though it demonstrated lower percentage of arbuscules when compared to healthy mycorrhizal ones. The obtained results showed that there was formation of arbuscules in the chickpea roots which confirms colonization by AM fungi (*G. fasiculatum*) was successfully established (Pandey, *et al*., 2005). The percentage of arbuscules were found to be highest in only healthy mycorrhiza inoculated chickpea plant as compared to diseased mycorrhizal ones (Plate- and Plate-).

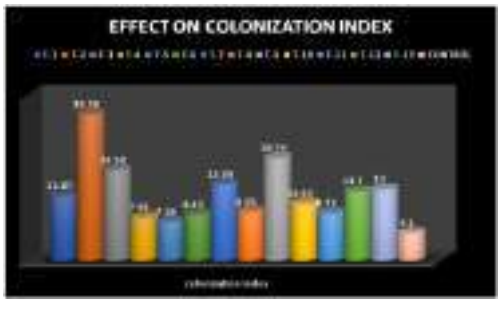
Table : 2 - Effect of talc based formulation of *Trichoderma virens, Trichoderma viride, Trichoderma harzianum* and *Glomus intrardece, Acaulospora scrobioculata* alone and in integrated on germination, growth and yield of chickpea infected with vascular wilt causing *F.oxysporum* f. sp. *Ciceris*

Treatment	Germination %	Dry weight of plant		Hight of plant		No. of pod	Yield	No. of nodules	Colonization index
		Shoot	Root	Shoot	Root				
T-1	93.33	2.33	0.6	25.66	8.66	7.66	4.6	18.00	11.87
T-2	100	3.9	1.33	34.00	14.33	14.00	8.4	38.00	26.58
T-3	83.33	4.13	1.46	34.33	14.66	14.66	8.8	35.66	16.52
T-4	86.66	4.03	1.46	34.00	15.66	14.66	8.8	33.33	7.96
T-5	86.66	3.93	1.23	34.00	13.66	11.66	7.0	33.33	7.16
T-6	90	3.80	1.13	32.33	12.66	10.66	6.4	26.66	8.45
T-7	83.33	3.7	1.03	31.00	11.00	10.00	6.0	16.66	13.95
T-8	93.33	3.60	1.00	30.66	10.00	9.33	5.6	13.66	8.95
T-9	90	3.4	0.86	30.00	9.00	8.66	5.2	10.66	18.74
T-10	90	4.16	1.66	35.66	17.3	17.66	10.6	18.66	10.42
T-11	90	4.26	1.86	36.00	18.00	17.66	10.6	17.33	8.73
T-12	93.33	4.83	1.86	36.00	19.00	19.00	11.4	16.33	12.70
T-13	93.33	5	1.9	34.00	19.00	17.00	10.93	15.00	13.00
CONTROL	96.66	1.33	0.2	23.66	5.33	4.33	2.6	9.00	5.1
S.Em±	NS	0.26	0.15	1.15	0.77	1.05	*0.64*	2.82	3.19
CD@5%	NS	0.76	0.44	3.35	2.24	3.04	1.86	8.17	9.26

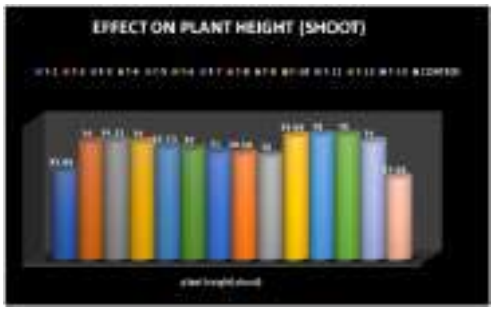
2.1 Effectof different treatment given in pots for the management of wilt disease and its effect on germination %.



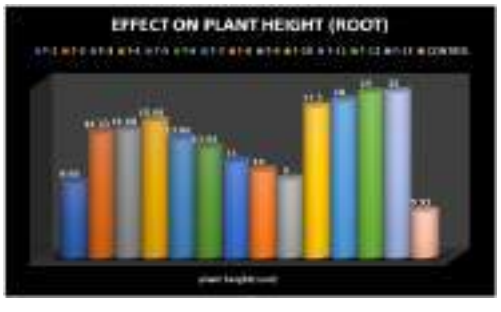
2.2 Effectof different treatment given in pots for the management of wilt disease and its effect on AM colonization index.



2.3 Effectof different treatment given in pots for the management of wilt disease and its effect on plant height growth(root).

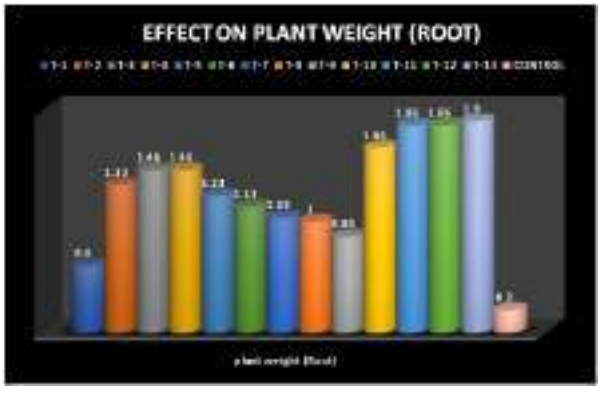


2.4 Effectof different treatment given in pots for the management of wilt disease and its effect on plant height growth(root).

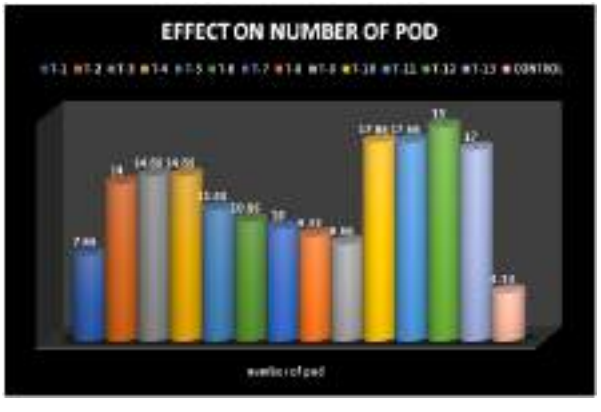


2.4Effectof different treatment given in pots for the management of wilt disease and its effect on dry plant weight growth(shoot).

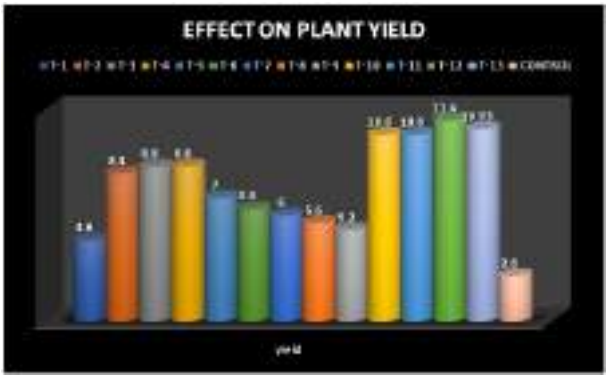
2.5 Effectof different treatment given in pots for the management of wilt disease and its effect on dry plant weight growth(root).



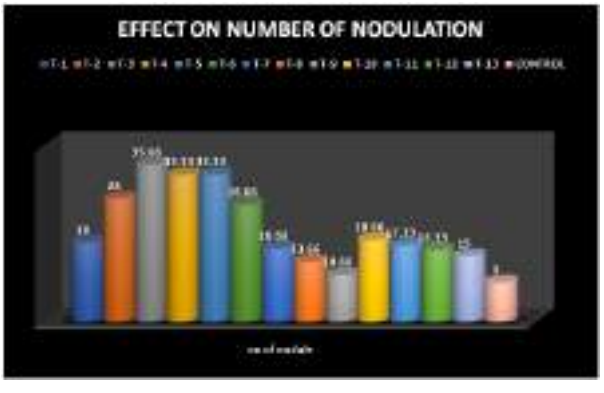
2.6 Effectof different treatment given in pots for the management of wilt disease and its effect on no of pod.



2.7 Effectof different treatment given in pots for the management of wilt disease and its effect on yield.



2.8 Effectof different treatment given in pots for the management of wilt disease and its effect on yield



CONCLUSION

Rapid colonization and greater protection provided to the germinating seeds by *T. harzianum*, *T. viride*, *T. virens*, *Acaulospora scrobioculata*, *Glomus intrardeces* might be the reason for superiority over control. In several cases, integration of biocontrol agents *T. harzianum*, *T. viride*, *T. virens*, *Acaulospora scrobioculata*, *Glomus intrardeces* with compatible treatment were found superior over any one treatment alone due to synergistic effect of the combined treatment and variation in the mode of action of the fungal and

bacterial biocontrol agents and obligate AM fungi. It may be due to mutual relation of individual microbes and other integral components. Integration of *Acaulospora scrobioculata*, *Glomus intrardeces* along with *Trichoderma spp.* provide high rate of protection by releasing secondary metabolites and supplying valuable nutritive material. *Acaulospora scrobioculata* and *Glomus intrardeces* are not only known to suppress the harmful micro-flora it is also making plant more tolerant by supplying a wide range of macro and micronutrient to plants from the soil. Consistent and indiscriminate uses of toxic and deadly killer chemical fungicide in soil is known to destroy biodiversity of pathogens as well as beneficial soil microflora and are therefore better control by biological means (Henis*et al.* 1978, Henis and Papavizas 1982, Hwang and Chakravorty 1993). In addition, the due to the nature of competition, *Trichoderma* is favoured and multiplied on dead mycelium of kind of host pathogen including *F. oxysporum* f. sp. *ciceri*. The present findings are also supported by the results of other workers that the fungal and *Acaulospora scrobioculata* and *Glomus intrardeces* provided significantly higher disease control in several crops than that obtained by either any one alone (Mukhopadhyaya 1994, Vidhyasekaran and Muthamilan, 1995 Kolte *et al*. 1998, Sen 2000). These treatments could be important components of organic forming for chickpea. The present study has demonstrated that the integration of *T. harzianum*, *T. viride*, *T. virens*, with *Acaulospora scrobioculata* and *Glomus intrardeces* can be used for not only the managing wilt disease and disease complexes of chickpea also would be essential ingredients for sustainable quality organic farming.

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RESOURCE USE EFFICIENCY AND PRODUCTION CONSTRAINTS OF MAJOR PULSES IN JAMMU REGION OF J&K: A STATISTICAL ANALYSIS

S. P. Singh[1], Akshay Deep[1], Jyoti Kachroo[1], M. C. Dwivedi[1], Anil Bhat[1], Nimit Kumar[2] Sanjeev Kumar[3] and Harminder Singh[1]

[1]. SKUAST- J, Main Campus, Chatha, Jammu, Jammu & Kashmir (180009), India

[2]. Chandigarh Group of Colleges, Mohali (Punjab), India

[3]. Department of Economics and Sociology, Punjab Agricultural University, Ludhiana, Punjab (141004), India

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ABSTRACT

The present study was conducted to study the resource use efficiency and production constraints of major pulses in Samba district of J&K during agriculture year 2016-17. A sample of 120 farmers was taken using multistage sampling technique for analyzing the results. The data related to resource use efficiency was analyzed using Cobb-Douglas production function and major constraints/problems were studied using mean percent score. The results revealed that the gross returns from urd bean cultivation can be significantly enhanced by using more quantity of human labour, machine labour, seeds and plant protection chemicals. Further, there is scope of using more of human labour and seeds in moong bean cultivation as revealed by their statistically significant regression coefficients. In gram cultivation, there is further scope of increasing the gross returns by using more human labour, machine labour and fertilizer. The results related to production constraints in major pulses revealed that high labour cost, unavailability of labour during peak period and involvement of uneducated members in farming were the main problems faced by the farmers in cultivation of major pulses in the study area.

Keywords : *Resource use efficiency, Cobb-Douglas production function, Constraints*

INTRODUCTION

Agricultural sector is the backbone of Indian economy providing employment to people about 52-58 per cent (Census 2011) to the total population of the country. Agriculture sector contributes about 16.5 per cent of Gross Value Added (GVA) (Anonymous, 2019-20). In order to meet the requirements of food & nutritional security of growing population, sustainable crop production is the main priority for scientists in India. In this context, pulses play a key role which is an integral part of many diets across the globe and they have great potential to improve human health, conserve our soil, protect the environment and contribute to global food security. The United Nation, declared 2016 as "International year of pulse (IYP) to heighten public awareness of the nutritional benefits of pulses as part of sustainable food production aimed at food security and nutrition (Anonymous, 2016).

In India, the cereals and pulses occupy about 3/4th of the gross cropped area under cultivation. India is the largest producer (18.2 million tonnes, largest consumer (22 million tonnes)

and the largest importer (3-5 million tonnes per year) of pulses. In India, the pulses are grown in around 24-26 million hectares of area producing about 17-19 million tonnes of pulses annually and accounts for over one third of the total world area and over 20 per cent of total world production (Meena *et. al*., 2014). Pulses are a critical and inexpensive source of plant-based proteins, vitamins and minerals for people around the globe. They have a low fat content, contain zero cholesterol, no gluten and are a significant source of dietary fibre, minerals and B vitamins.Crop residues of pulses and legumes in general, can also be used as animal fodder, thus increasing the quality of the animal diet.Furthermore, pulses can play an important role in climate change adaptation, since they have a broad genetic diversity from which climate-resilient varieties can be selected and/or bred (Anonymous, 2016).

During the last decade, growth in pulse production has increased significantly. The total pulse production has been increased from 6.43 million tonnes to 19.78 million tonnes, while yield has been increased from 377kg/ha to 689 kg/ha during the period from 1950-51 to 2013-14 (Anonymous, 2016). More recently, under the National Food Security Mission (NSFM), high priority has been given for increasing the production of pulses across the country to curtail growing imports, arrest protein malnutrition and make pulses available at affordable price to the common people. In J&K state, the area under pulses was to the extent of 27440 ha with an annual production of 141 thousand quintals during the year 2011-12. Jammu region is ahead of Kashmir both in area (17681 ha) and production (71 thousand quintals) of pulses. Among Pulses, chickpea (45.1 per cent) occupies the major share. In the same time much of the pulses production has slowly shifted from Kharif to Rabi season with a share of around 60 per cent of the total pulse production. Therefore, more emphasis is required to be given on Rabi pulse crops (Reddy*et al.*, 2013). As far as area, production and yield of mungbean in J&K is considered, it was found to the extent of 1.4 thousand hectare, 0.8 thousand tonnes and 587 kg/ha, respectively for the year 2014-15 whereas for urdbean, it was found 97.5 thousand hectare, 82.3 thousand tonnes and 845 kg/ha, respectively (Anonymous, 2016-17).

Being the largest pulse producing country, there is stagnation in the area under pulses production. In India the important reasons for stagnation of production of pulses is the replacement of pulse area by high yielding varieties of cereals and other crops following expansion of irrigation facilities in dry areas. There is also a gap between potential and actual yield of the pulses in the country and reducing this gap would substantially increase country's pulse production. In addition to that the potential areas of pulses may be identified and supported technologically and institutionally to increase area under pulses. Keeping all these factors in view, the present study was undertaken in Samba district of J&K to study the resource use efficiency and major production constraints of major pulses grown in the study area.

MATERIALS AND METHODS

The present study was conducted during agricultural year 2016-17 in Samba district of J&K state purposively using multistage sampling technique. At the first stage of sampling, Nud and Samba blocks of Samba district were selected purposively. At the second stage of sampling, 5 villages each from selected blocks were selected randomly. At the third stage of sampling, 12 farmers from each village were selected through random sampling technique without replacement to constitute a sample size of 120 farmers in total. Both

primary as well as secondary data were used as per the requirements of the study. The primary data were collected by survey method by interviewing the pulse growers directly through a pre-tested schedule and required secondary data were collected from various government departments, publications, journals, books etc.

Resource use efficiency

In order to study the resource use efficiency of major pulses, Cobb-Douglas production function was used.The fitted Cobb-Douglas production function written for the present case with five input variables was as given below:

Est. $Y = a_0 X_1^{b1} X_2^{b2} X_3^{b3} \ldots X_5^{b5}$

Where,

Y represents Gross returns (`/ha)

X_1 represents Human labour (`/ha)

X_2 represents Machine labour (`/ha)

X_3 represents Cost of Seed (`/ha)

X_4 represents Manure & fertilizers (`/ha)

X_5 represents Plant protection chemicals (`/ha)

$b_1 \ldots b_5$ are estimated regression coefficients.

The productivity of different inputs used in pulses production was examined by calculating marginal value productivities of inputs which were estimated by using following formula:

$$MVP\ X_i = b_i \frac{Y(G.M.)}{X_i(G.M.)}$$

Where,

MVP (X_i) is the marginal value productivity of i^{th} resources

b_i is the regression Coefficient (estimated)

GM (Y) is the Geometric Mean of Output (yield)

GM (X_i) is the Geometric Mean of i^{th} resources.

Production Constraints

The production constraints for cultivation of various pulses were analyzed using Mean Percent Score (MPS) by recording the response of sampled farmers. The total score obtained by each respondent as well as for each statement was calculated. Finally mean percent score (MPS) was calculated by the following formula.

$$\text{Mean percent score} = \frac{\text{Total score obtained}}{\text{Maximum obtainable score}} \times 100$$

Table : 1 - Estimated regression coefficients of various factors, their standard errors and Marginal Value of Product (MVP) for urd bean cultivation on selected farms

Variables	Regression Coefficients	Standard Error	MVP
Constant (α)	1.338	0.266	-
Human labour (X_1)	0.184*	0.431	1.17
Machine labour (X_2)	0.285***	0.423	3.26
Seeds (X_3)	0.315**	0.411	8.00
Fertilizer (X_4)	-0.095***	0.518	-1.70
Plant protection chemicals (X_5)	0.268**	0.369	7.70
Coefficient of Determination (R^2) = 0.88			

*, ** and*** means significant at 1 %, 5% and 10% level of significance, respectively

Table : 2 - Estimated regression coefficients of various factors, their standard errors and Marginal Value of Product (MVP) for moong bean cultivation on selected farms

Variables	Regression Coefficients	Standard Error	MVP
Constant (α)	1.176	0.058	-
Human labour (X_1)	0.454**	0.040	2.70
Machine labour (X_2)	0.099	0.028	0.94
Seeds (X_3)	0.043*	0.017	0.98
Fertilizer (X_4)	0.201	0.018	4.52
Plant protection chemicals (X_5)	0.145	0.018	3.40
Coefficient of Determination (R^2) = 0.95			

*, ** means significant at % and 5% level of significance, respectively.

Table 3:Estimated regression coefficients of various factors, their standard errors and Marginal Value of Product (MVP) for gram cultivation on selected farms

Variables	Regression Coefficients	Standard Error	MVP
Constant (α)	1.141	0.040	-
Human labour (X_1)	0.528	0.059	3.49
Machine labour (X_2)	.097**	0.045	1.31
Seeds (X_3)	0.005*	0.064	0.04
Fertilizer (X_4)	0.080	0.020	2.52
Plant protection chemicals (X_5)	-0.258***	0.047	-4.94
Coefficient of Determination (R^2) = 0.97			

*, ** and*** means significant at 1 %, 5% and 10% level of significance, respectively

Table 4: Constraints faced by the pluses growers in its cultivation

S. No.	Constraints	Number of farmers (N) Urdbean (N=120)	Moongbean (N=120)	Gram (N=120)
1.	High labour cost	110 (91.67)	100 (83.33)	115 (95.83)
2.	Unavailability of labour during peak period	87 (72.50)	90 (75.00)	85 (70.83)
3.	involvement of uneducated members in farming	65 (54.17)	70 (58.33)	64 (53.33)
4.	Lack of latest technical knowledge	45 (37.50)	50 (41.67)	44 (36.67)
5.	Lack of finance and credit facilities	40 (33.33)	35 (29.17)	22 (18.33)
6.	Occurrence of diseases and insect-pest	36 (30.00)	30 (25.00)	50 (41.67)
7.	High cost of pesticides and insecticide	32 (26.67)	25 (20.83)	25 (20.83)
8.	Lack of good quality seed	30 (25.00)	26 (21.67)	20 (16.67)
9.	Uncertain rainfall pattern	28 (23.33)	25 (20.83)	25 (20.83)

Figures in parentheses are the percentages of the total number of farmers.

RESULTS AND DISCUSSION

The resultsrelated to resource use efficiency and marginal value of productivity (MVP)of major pulses (urd bean, moong bean and gram) in study area was estimated and has been presented in Table 1,2 and 3.

Resource use efficiency of urd bean

Gross returns of urd bean was regressed on various factors of production viz., human labour, machine labour, seed, fertilizer and plant protection chemicals. These variables were taken as the explanatory variables.The perusal of the data depicted in Table 1 revealed that 88 per cent of the total variation was explained by independent variables in the dependent variable as indicated by significant value of coefficient of determination (0.88).The results in Table 1 further indicated that the regression coefficient of machine labour was significant at 10 per cent level of probability and fertilizer was found to be negatively significant at 10 per cent level of probability and their values were0.285and -0.095, respectively. The regression coefficients of seed and plant protection chemicals were significantat 5 per cent level of probability. The regression coefficient of human labour was significantat 1 per cent level of probability.It was observed that the marginal value productivity of machine labour, human labor seed andplant protection chemicals were positive with their values at 3.26, 1.17, 8.00 and 7.70 respectively and the resource use efficiencyestimated for fertilizer was negative with their values at -0.095, respectively.The results related to MVP indicated that there is further scope of increasing the returns by using more machine labour, human labour, seeds and plant protection in Urd bean.

Resource use efficiency ofmoong bean

The results related to resource use efficiency of moong bean have been presented in Table 2. The perusal of the data revealed that in the analysis of crop production function, coefficient of determination (R2) value was 0.95 which was statistically highly significant, meaning that 95 per cent of the total variation in dependent variable was due to independent variables included in the model. Further, the results indicated that the regression coefficients of machine labour, fertilizer and plant protection were non- significant. The regression coefficient of seed was found to be significant at 1 per cent level of probability and human labour was found to be significant at 5 per cent level, with their values of 2.70 and 0.98 which indicated that there is further scope of increasing the productivity and return by using more human labour, machine labour, seed, fertilizer and plant protection in moong bean.

Resource use efficiency of Gram

The perusal of the data depicted in Table 3 revealed that in the analysis of crop production function, coefficient of determination (R^2)value was 0.97 whichwas statistically highly significant meaning that 97 per cent of the total variation in dependent variable was due to independent variables included in the model.Table 3 further indicated that the regression coefficient of seed was significant at 1 per cent level of probability,machine labourwas found to be significant at 5 per cent level of probabilityand their values were 0.005and 0.097, respectively. The regression coefficient of human labour and fertilizer were non-significant.It was also observed that the resource use efficiencyof plant protection chemicals was found to be negatively significant at 10 per cent level of probability with its value of -4.49. The results related to MVP indicated that there is further scope of increasing the productivity and return by using more human labour, machine labour, and fertilizer in Gram.

The above findings related to resource use efficiency and marginal productivity of major pulses

are supported by Divya, 2014 and Pawar *et. al*., 2014.

Production constraints faced by major pulse crops producer's in the study area

The various individual aspect wise production constraints were worked out in the study area (Table 4). The results revealed that in urd bean, major production constraints were high labour cost, unavailability of labour during peak period and involvement of uneducated members in farming as revealed by 91.67, 72.50 and 65 per cent of the farmers, respectively in the study area. Similar trend of constraints were found case of moong bean and gram cultivation in the study area. For moong bean cultivation, 83.33 per cent farmers were facing high labour cost constraint followed by unavailability of labour during peak period (75%) and involvement of uneducated members in farming (70%). Similarly, 95.83 per cent farmers were facing high labour cost constraint in gram cultivation followed by unavailability of labour during peak period (70.83%) and involvement of uneducated members in farming (64%).

CONCLUSIONS

From the results of the present study, it can be concluded that in case of urd bean, Machine labour, seeds, fertilizers and plant protection chemicals significantly affected the gross returns. Similarly, human labour and seeds affected the gross returns in moong bean significantly. Further, machine labour, seeds and plant protection chemicals were found to be significantly affecting the gross returns of gram cultivation in the study area.The major production problems/constraints faced by pulses growers in the study area were found to be high labour cost, unavailability of labour during peak period, involvement of uneducated members in farming, lack of latest technical knowledge, lack of finance and credit facilities, occurrence of diseases & insect-pest and high cost of pesticides and insecticide, lack of good quality seed and uncertain rainfall pattern.

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STUDY ON SOIL FERTILITY STATUS OF AONLA PLANTED AREA IN THE DISTRICT OF PRATAPGARH OF UTTAR PRADESH

P. K. Upadhyay and P. Sirothia
NRM Faculty of Agriculture. MGCGV Chitrakoot, Satna, M.P, India

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ABSTRACT

The study was conducted on the soil fertility status of the aonla planted area in the district of Pratapgarh of Uttar Pradesh. There are 17 blocks in the district but 5 block and Three villages from each block were selected On the Basis of Aonla orchard availability from each development block namely Patti, Belkharnath, Sadar, Sangipur, and Sanwa chandrika were selected for soil profile study. The result from the study showed that the organic carbon content in the pedon 15 and 16 are in medium categrt whilerest are in low. The available N content of each block were found low category showed positive co – relation with the carbon content of the soil. The available Macro nutrient N P K & S value decreased with the depth. The S content is found to be comparatively higher in the Sadar (Bhuwalpur) and Bababelkharnath Dham (Amerpur). The available Zn content is low to high. B content is higher in all the blocks. The various results obtained from the different soil test in the laboratory and collect the data about the nutrients status of the soil of the five blocks under study and based on these findings, a balanced recommendation of fertilizers and manures to various crop can be made that will help in increasing the productivity of different food crops and orchards.

Keywords *: Soil fertility, nutrient, organic carbon, nitrogen.*

INTRODUCTION

Aonla is commonly known as Indian Gooseberry (*Emblica officinalis* Gaertn syn. *Phyllanthus emblica* L.) finds a special place in India as it has got tremendous medicinal values. Aonla is an antiquated fruit of Indian origin, which is allied with our traditional, culture and bequest. In Uttar Pradesh, Aonla holds an important position as leading grown over an area of 35.16 thousand hectares with an annual production of 384.30 thousand metric tons (NHB, 2017-18). In Pratapgarh region, it is holds an important position as leading area and production of Aonla crops among the country followed by Allahabad, Mathura and Azamgarh. It occupies an area of about 17.14 thousand hectares with an annual production of 187.86 thousand metric tons (NHB, 2017-18).In Pratapgarh, the various environmental conditions and a range of soil fertility under Aonla orchard directly sustain quality production. The natural drainage varies from good to poor. Partial sodic, and slightly silt. Soil texture varies from heavy clay to sand; organic matter from less than 1% to more than 70% of the district soil; and pH from less than 6 to more than 10 (SREP 2006) Gov. of U.P. Pratapgarh. The vast tracts of Usar land widely spread in various parts of the Sultanpur district of Uttar Pradesh offer ample scope for Aonla cultivation. Of late, commercial cultivation of Aonla has come up in some parts of Tamil Nadu, Andhra Pradesh,

Rajasthan, and Madhya Pradesh also.

Though, Anola is a very hardy species that can be successfully grown in variable agro-climatic and soil conditions viz., sodic and saline soils up to 35 ESP and EC 9 dSm-1 respectively It is suitable for marginal lands and does not require much care In recent years, aonla has been identified as an ideal plant for various kinds' of wastelands, viz. moisture stress, eroded, ravines, upland, riverbeds, and areas with undulated topography (Pathak and Pathak 2001). The calcium carbonate content in soils showed an increasing trend with depth and it increased significantly with an increase in the sand, available calcium, pH, and magnesium. The soils of study areas were non-saline and EC values decreased with the increase of soil depth. The organic carbon content in soils was found below. Further, several scientists was reported the available micronutrients Fe, Zn, and B contents in soils of most of the orchards had been found deficient while, Cu and Mn were found medium deficient.

MATERIALS AND METHODS

Experimental site

Investigational site located in Pratapgarh district which consists of five development block namely Sangipur, Sandawa Chandrika, Sadar, Patti and Baba Belkharnath. All the fifteen villages were selected from five development block the study.

S. No.	Development Block	Name of village
1	Sangipur	Atheha, Muraini and Rahatikar
2	Sandawa chandrika	Adharpur, Bhadoshi and Taranpur
3	Sadar	Bhupiyamau, Bhuwalpur and Gonde
4	Patti	Bibiykaranpur, Dubauli Parsan and Kukuwar
5	Baba belkharnath Dham	Amerpur, Gopalpur and Rakha

Collection of soil samples

There are 17 blocks in the district but 5 block and three villages from each block were selected On the Basis of Aonla orchard availability from each development block namely Patti, Belkharnath, Sadar, Sangipur, and Sanwa chandrika were selected for soil profile study. Three representative soil profiles in each village were exposed. At each location 2-4 composite samples were taken from different horizons viz., 0-20, 20-40, 40- 60, 60-80, 80-100 cm segments Fifteen soils samples collected randomly from different sampling location in each block of normal soils. The samples were collected with the help of post-hole auger from different level. The soil samples of problematic soils were also collected randomly from different sampling location in each block depending upon the area under salt-affected soils.

Table 1.1 Methods used for chemical analysis of soils

Sr. No.	Parameter	Method	Reference(s)
Chemical analysis of soil			
1.	Soil pH	Potentiometric method	Jackson (1973)
2.	Electrical conductivity	Conductimetric method	Jackson (1973)
Analysis of soil fertility status			
3.	Organic carbon	Rapid titration method	Walkley and Black (1934)
A. Available macro-nutrients			
4.	N	Alkaline potassium permanganate method	Subbiah and Asija (1956)
5.	P	Colorimetric method	Olsen et al. (1954)
6.	K	Flame-photometric method	Merwin and Peech (1951)
7.	Ca and Mg	Atomic Absorption Spectrophotometric method	Sarma et al. (1987)
8.	S	Turbidimetric method	Jackson (1973)
B. Available micronutrient			
9.	Fe, B, Mn, Zn and Cu	Atomic Absorption Spectrophotometric method	Lindsay and Norvell (1978)

RESULTS AND DISCUSSION

Soil pH The data in Table 1.2showed that the soils in pedon 4,5,9,15 are normal ph range 7.1 to 7.7 while pedon 1,2,3,6 are alkalinity in nature values ranging from 8.1 to 8.95 and it increased with depth. This might be due to accumulation of calcium carbonate and bases in the lower horizons. Similar results were reported by (Magar 1990) in black soils of Purna valley.

Electrical conductivity (EC) The range 0.3-1.27 showed that there soils are non saline in nature. EC of the surface soils was lower than that of subsurface soils and in general increased with depth. This may be due to leaching of salts from the surface to the subsurface horizons through pedogenic processes. Similar observations were also recorded by (Kharche 1990).

Fertility status of aonla planted soils:

The soils of all the pedons of pratpgarh district were estimated for availability of Macro and micro nutrients contents to assess the fertility status of soils. The average of the profile details of fertility status of pedons is given in table 1.1.

Organic carbon

The organic carbon content of the study area soils varied from 0.21-0.46 percent with a mean value of 0.27% (Table 1.1). Higher organic carbon percentage was observed in descending order in pedon 15,14,10,11,8,9,1,6,4,7,2,13,12,5, and 3. In general, the organic carbon content decreased gradually with an increase in the depth, which is mainly due to the accumulation of plant residues on the soil surface and less movement down the profile due to rapid rate of mineralization at higher temperature and adequate soil moisture level. Similar results were observed by (Sarkar et al. 2001).

Available Macro nutrients

Available nitrogen It can be seen from the Table 1.1 that the available nitrogen content varied from 147-273kg ha^{-1} with an average value of 202 kg ha^{-1}. The maximum (273 kg ha^{-1}) available nitrogen was found in the sampling pedon 15 and the minimum (147 kg ha-1) . All pedon in the study area are fall in low category. N would be expected to mineralize a significant amount of N during the succeeding crop cycle showing that most of the soils have good potential of N mineralization (Hartz et al., 2007).

Available phosphorus According to table 1.1 the available phosphorus status ranged from 7.9-43 kg ha^{-1} with a mean of 18.09 kg ha^{-1}. The maximum amount of available phosphorus (43 kg ha^{-1}) was found in pedon 15 and the minimum (7.5 kg ha^{-1}) was observed in pedon 1, which could be categorized from very low to very high Jones, 2003, Relatively the maximum available P was recorded in pedon 15 where the pH was slightly alkaline (7.45), the pH value where P fixation is low. P-Olsen between 12 and 18 mg kg^{-1} is considered as sufficient (Carrow et al., 2004) and hence the available P in surface horizons of all pedons was in sufficient range. On the basis of limits suggested by (Muhr et al. 1963).

It was also reported that soil P is more available in warm soil than in cool soil (Hartz, et al., 2007). Therefore, P availability in the soils might have been favored by the warm climatic condition of the study area along with the preferred pH range. Available P values declined with increasing depth which could be attributed to decrease in soil OM. The increase in clay content with depth could have also contributed to decrease available P, although this was not confirmed by the correlation analysis.

Available potassium The available range of potassium in the profile content of the soils of all the pedons varied from 125-257Kg ha^{-1} Table 1.1 with a mean of 187.09 Kg $ha^{-1}$and could be categorized from medium to very high (Jones, 2003). The highest available K in mean value of pedon (257 Kg ha^{-1}) was recorded in the Pedon 7, whereas the smallest mean value (150 Kg ha^{-1}) was in the Pedon 8 and the values generally decreased

with depth were observed and were attributed to the difference in weathering rate (Liu, 2011).

Available Sulphur Table 1.1 indicated that the available S content in soils was found to differ from 0.47 to 26.0 mg kg^{-1} with a mean value of 0.52-0.74mg kg^{-1}. Considering highest content was found in pedon 8,13,7, 12, and 14. Sulphur content was deficient in pedon 4,6, 3, 5, 6, 9, 10 and 15. Sulfur deficiencies are notoriously transient because as the season progresses crops often access S deeper in the soil profile and warmer temperatures result in S mineralization from OM and crop residues. Similar findings were reported by (Bhatnagar et al. 2003).

Available Boron The data pertaining on available boron contents presented in table 1.1 in aonla planted soils of Pratapgarh it ranged in soil profile 0.54-1.96 mg kg^{-1} with a mean of 0.79.65 mg kg^{-1} and could be categorized from medium to high. The highest content of available Boron was recorded in pedon 13 (1.96 mg kg^{-1}) whereas lowest range contents of boron was found in pedon 3 (0.54mg kg^{-1}).

Micronutrient status:

Available –Zn The data on available zinc average range of pedons presented in table 1.1. The available zinc extracted by DTPA varied from 0.70-16.8kg^{-1} with the average content of 0.63 mg kg^{-1}. Highest zinc content was observed in pedon 8 (16.8 mg kg^{-1}) and lowest was found in pedon 6(0.70 mg kg^{-1}). These soils were also found to contain low to high zinc in their soils. Considering critical limit of 0.6 mg kg^{-1}given by (Katyal and Rattan 1993), the soil under study was categories as a deficient in available zinc status. The study revealed that the out of all pedons in here, 74.90 percent soil samples found to have a zinc deficiency while pedon 7,14, 11, 8, 9, 4, 6 and 1 showed the very high availability of zinc. Similar observation was recorded by (Gajbhiye et al. 1993) .

Available –Cu Table 1.1 reveal that the degree of availability of copper extracted by DTPA varied from 1.9-9.6mg kg^{-1} with signify value of copper availability is 5.55 mg kg^{-1}. The highest mean value of the pedons is (9.01mg kg^{-1}) recorded in pedon 2 where lowest mean value (2.85 mg kg^{-1}) recorded in pedon 5&6. Considering critical limit of 0.2 mg kg^{-1} as suggested by Katyal and Rattan (2003), these soils are categorized as higher availability of copper content. According to this classification of availability of copper content, here all pedons show very well copper availability. Similar results were reported by (Jibhkate et al. 2009).

Available –Fe The data in Table 1.1 showed the DTPA extractable Fe in soils of aonla planted soils of Pratapgarh district. The amount of available Fe mean values of the profile content in soils is ranges between 3.02-4.66 mg kg^{-1} with mean value of Fe availability is 4.15 mg kg^{-1}. The highest value of (4.6 mg kg^{-1}) recorded in pedon 6 where lowest value (3.02 mg kg^{-1}) recorded in pedon 1. Considering critical limit for DTPA-Fe 2.5-4.5 mg kg^{-1}as given by (Katyal and Rattan 2003) these soils were found to be sufficient in available Fe content. According to this suggestion of availability of Fe content, here all pedons show very well Fe availability Comparable observation was reported by (Jibhkate et al. 2009).

Available –Mn Table 1.1, magnitude of available manganese content in soils soil profile ranged from 2.57-4.22 mg kg^{-1} in aonla planted soils of pratapgarh district with mean value of Mn availability is 3.5 mg kg^{-1}. The highest range value of the profile (4.5 mg kg^{-1}) recorded in pedon 2 where lowest value (2.5 mg kg^{-1}) recorded in pedon 1. Considering critical limit of 2.0 mg kg given by (Kattyal and Rattan 2003) these soils were well supplied with manganese. In pursuance of this categorization of availability of Mn content, here all pedons show very well Mn availability . Similar finding were recorded by (Jibhkate et al. 2009) and (Chinchmalatpure et al. 2000). The micronutrient content of soil is determined by the chemical composition of its parent material.

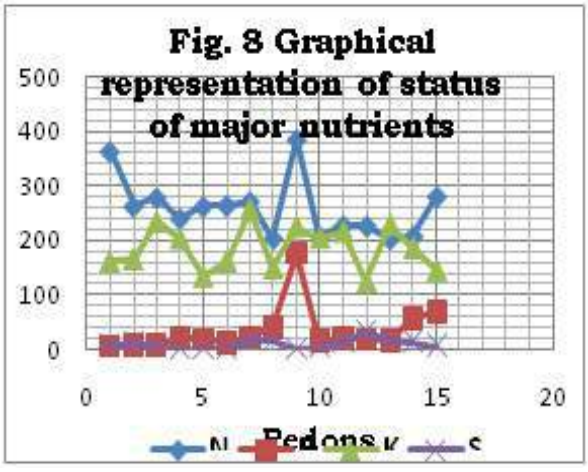
Fertility status of the pedons of Pratapgarh district (U.P.)Table 1.1

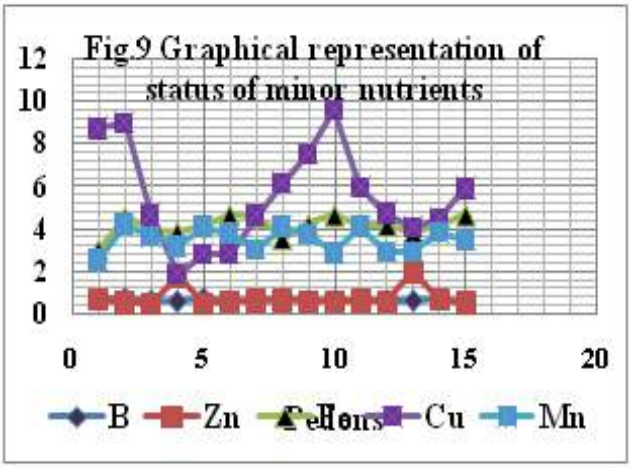
(Mean values of each pedon)

Pedon No.	OC (Organic carbon)	Available Macro Nutrients (Kg ha^{-1})			Available Micro Nutrients (Mg Kg^{-1})					
		N	P	K	Zn	S	B	Fe	Cu	Mn
1	0.34	182	7.56	161.8	8.822	0.69	0.744	3.02	8.732	2.576
2	0.26	195.4	8.08	165.8	10.664	0.74	0.56	4.52	9.012	4.222
3	0.21	147	7.98	235	4.838	0.64	0.54	3.96	4.666	3.662
4	0.26	215.8	16.2	204.4	1.56	0.6	1.74	3.86	1.928	3.196
5	0.26	222.4	15.2	134.2	1.366	0.74	0.54	4.16	2.85	4.102
6	0.25	202.6	12.4	202.2	0.704	0.64	0.64	4.66	2.858	3.814
7	0.23	206.4	19.8	257.8	13.524	0.6	0.66	4.6	4.668	3.056
8	0.25	182.4	20.6	150	16.8	0.7	0.696	3.56	6.198	4.1
9	0.24	192.6	16.46	226.2	1.468	0.64	0.594	4.2	7.558	3.754
10	0.28	211.2	16	205.4	5.12	0.64	0.61	4.66	9.6	2.888
11	0.25	187.4	20.8	216.8	9.84	0.66	0.686	4.18	5.992	4.12
12	0.22	189	18.8	125	13.94	0.64	0.618	4.18	4.766	2.954
13	0.25	181.6	17.4	229.6	15.8	0.64	1.96	3.86	4.11	2.954
14	0.37	243	31.2	187	14.05	0.74	0.72	4.16	4.488	3.846
15	0.46	273.8	43	145.2	6.65	0.52	0.56	4.66	5.936	3.472
Average	0.27	202.1	18.09	189.760	8.34	0.655	0.79	4.149	5.55	3.5144
Range	0.21-0.46	147-273	7.9-43	125-257	0.70-16.8	0.52-0.74	0.54-1.96	3.02-4.66	1.9-9.6	2.57-4.22

Table 1.2

Pedon No.	P^H	EC (dSm/m)
1	8.98	0.65
2	8.778	0.634
3	8.184	0.874
4	7.97	0.312
5	7.288	0.3
6	8.272	0.642
7	7.758	0.718
8	7.518	0.982
9	7.7	1.272
10	7.852	0.467
11	7.636	0.4216
12	7.792	0.5612
13	7.938	0.574
14	8.23	0.486
15	7.414	0.662
Average	7.954	0.637
Range	7.2-8.9	0.3-1.27





CONCLUSION

- ✓ **Fertility status of aonla planted soils in Pratapgarh,**
- ✓ In general, the organic carbon content decreased gradually with an increase in the depth, which is mainly due to the accumulation of plant residues on the soil surface and less movement down the profile due to rapid rate of mineralization at higher temperature and adequate soil moisture level.
- ✓ Total N content decreased with depth in all pedons (Table 1.1). On the basis of the ratings of nitrogen contents was suggested by (Subbiah and Asija 1956),
- ✓ Available P values declined with increasing depth which could be attributed to decrease in soil OM. The increase in clay content with depth could have also contributed to decrease available P, although this was not confirmed by the correlation analysis.
- ✓ The highest available K in mean value of pedon (257 Kg ha^{-1}) was recorded in the Pedon 7, whereas the smallest mean value (150 Kg ha^{-1}) was in the Pedon 8 and the values generally decreased with depth were observed and were attributed to the difference in weathering rate (Liu, 2011).
- ✓ S content in soils was found to differ from 0.47 to 26.0 mg kg^{-1} with a mean value of 0.52-0.74mg kg^{-1}. Considering highest content was found in pedon 8,13,7, 12, and 14. Sulphur content was deficient in pedon 4,6, 3, 5, 6, 9, 10 and 15. Sulfur deficiencies are notoriously transient because as the season progresses crops often access S deeper in the soil profile and warmer temperatures result in S mineralization from OM and crop residues.
- ✓ Zn in the soil under study was categories as a deficient in available zinc status. The study revealed that the out of all pedons in here, 74.90 percent soil samples found to have a zinc deficiency while pedon 7,14, 11, 8, 9, 4, 6 and 1 showed the very high availability of zinc.
- ✓ Result shows in the Table 1.1 that Available Cu, Mn B, & Fe, micro nutrients content in the study soil pedons, found to be high in category, or very well availability found in the all profile of the study area.

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HEALTH BENEFITS OF THE MORINGA PLANT

Chetan D.Thakur and K. S. Dahiya

Research Scholar

Department of Botany and Faculty of Basic and applied science

Madhav University, Pindwara, Abu Road, Rajasthana

[2]State Urban Development Agency, Saltlake, Kolkata-700106, India

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ABSTRACT

This paper review the work done and the efforts to develop participations amongpeople. Moringa oleifera plant is widely used to treat many diseases.The present review is an attempt to highlight various health benefits of the Moringa oleifera whoseplant parts are being used for number of ailments such as diabetes, kidney problem,healings, antibacterial, antifungal, anticancerous, and also used asantioxidant. This review highlights the pharmacologic effects and therapeutic effects of *Moringa* oleifera. The chemical constituents andcompoundpresent in different parts of the plant are also important variously.

Keywords : *Moringa, health, benefit*

INTRODUCTION

Moringa oleifera , the "miracle tree." or horse radish tree, ben tree, and **drumstick tree**. is mainly tried to persuade people for its valuable high concentration of antioxidants **and** its ability to lower blood sugar, improve heart health, and reduce inflammation like health benefits.This small tree has been highly valued for centuries in India, where it is used in everything from fiber, rope and dye, to fertilizer, spices and medicines.

A-Morphological Characteristics

. *M. oleifera* is a fast-growing, deciduous tree reaching a height of 32–40 ft and trunk diameter of 1.5 ft. The bark has a whitish-grey colour and is surrounded by thick cork. Young shoots have purplish or greenish-white, hairy bark. The tree has an open crown of drooping, fragile branches and the leaves build up a feathery foliage of tripinnate leaves. It is often cut back annually to 3–6 ft, and allowed to regrow so the pods and leaves remain within arm's reach.

The Moringa plant

B- Floral Characteristics

The flowers are fragrant and hermaphroditie. Flowering begins within the first six months after planting, flowering only occurs once a year and with constant rainfall, flowering can happen twice or even all year-round. Flowers grow on slender, hairy stalks in spreading or drooping flower clusters which have a length of 10–25 cm ,they are surrounded by five unequal, thin, yellowish-white petals. The flowers are about 1.0–1.5 cm long and 2.0 cm broad.

The fruit is capsule, 20–45 cm in size, hanging, three-sided brown , globular seeds with a diameter around 1 cm. The seeds have three whitish papery wings and are dispersed by wind and water.

OBSEVATIONS: USES AND IMPORTANCE

All plant parts are useful and edible, its seeds, flowers, fruits, roots and leaves are used for food, and each plant part, packed with phyto nutrients, proteins and minerals. **Moringa** leaves have most potent nutritional content and healing properties.The leaves are edible raw and cooked, dried and ground in powders or capsules

The light-green colored, earthy-tasting powder derived from the leaves and seed pods are said to contain beta-carotene, quercetin, vitamins and minerals such as calcium, iron,potassium and protein.The powdered form, suggests same health benefits as the fresh leaves. These are some of the main health benefits of the plant parts.

Moringa leaf is a useful in maintaining blood sugar and is natural supplement for treating and preventing diabetes.**Moringa** helps prevent sugar spikes after meals and reduces fasting blood sugar levels in both diabetic and non-diabetic creatures. Maintaining healthy blood sugar is key to reducing inflammation, boosting mood, and preventing heart disease and diabetes. Antioxidants present in **Moringa** help to protect insulin-producing cells from damaging.

The phytochemicals in **Moringa** leaves also help to protect the kidney and retinas from diabetes-related damage. Moringa supplementation can help to restore functions of kidney and pancreas

Moringa is a powerful anti-inflammatory agent, and helps soothe chronic inflammation in the body by suppressing inflammatory enzymes and boosting production of anti-inflammatory cytokines, reducing inflammation and in increasing longevity, strength, and resilience to chronic diseases such as diabetes, arthritis, and obesity.

Moringa is impresive in boasting an anti-oxidants including vitamins C and E, flavonoids and polyphenols.These compounds removes harmful free radicals, and protect cells from oxidative stress, DNAdamage, and inflammation. Reducing blood sugar, inflammation, and oxidative stress help to prevent unwanted weight gain.

Several compounds present in **Moringa** acts as antibacterial, antiviral, antifungal, and antiparasitic, useful in food preservation and water purification, protecting food-borne bugs like salmonella or fungi.**It** is used in treatment against herpes simplex virus and HIV.

Moringa in diet can boostresilience against blood or digestive bacterial infections.

Seed oils applied topically can fight fungal skin infections and acne.

Moringa leaves have a potent dose of antioxidants, compounds neutralizing free-radicals that can damage cells and DNA to trigger tumor development ,**hence** play an exciting role in cancer treatments such as chemotherapy. Leaf extracts possessing glucosinolates and quercetin help inhibit growth and trigger cell death in growing tumors. Along with these exciting cancer-fighting properties, leaf extracts increases the effect of chemotherapy in human pancreatic cells.

High anti oxidant content in Moringa plant has an ability to protect brain tissue against neuro degeneration and damage.**L**eaf extract treat memory related disorders such as Alzheimer's and dementia. It is supposed to regulate and restore healthy neuro transmitter levels after Alzheimer's-like brain damage.

Moringa used in diet although have high non-soluble calcium oxalates but without making any harm or worrying about kidney stones ,it is easily excreated through body.

Moringa leaf boost internal glow of human bodyand its oils can boost exterior glow. Oil obtained from pressed seeds and leaves rich in vitamin and anti oxidant is concidered as an excellent skin cleanser, hydrating moisturizer or hair care taker. High vitamin C leval boost natural collagen production and protect skin from oxidative stress, fighting wrinkles, sagging and sun damage, its anti-inflammatory and antimicrobial properties can help in skin problems like acne or blackheads. Oil heal wounds and skin damage by producing collagen and fibro blasts, promoting the growth and movementin wound healing.

As potent plant based iron compounds in Moringa is an ideal iron supplement which improve iron absorption levels, increase red blood cell counts, and prevents the breakdown of red blood cells seen in sickle-cell anemia.

Leaf powder of Moringa along with Amaranth leaf powder to post menopausal women can make them feel better in harmonal out of whack. Use of this leaf powder for three months, is said to have decreased markers of oxidative stress, better fasting blood glucose and increased hemoglobin levels, improves thyroid health, which controls hormones related to energy, sleep, and digestion.

Moringa is said to contain high concentrations of polyphenols to reverse oxidation in the liver and has shown to reduce liver fibrosis and protect against liver damage. Certain compounds present in moringa help to protect the liver against toxins or drug exposure, high antioxidant content and its ability to detoxify heavy metals make it an ideal supplement for supporting kidney and liver health.

Moringa leaves have long been used as a traditional remedy to enhance breast milk production after giving birth

RESTRICTIONS IN USE

Generally M**oringa** is safe and beneficial to

be taken in diet, but it is always a good idea to plan its use to treat any specific disease. Extracts of the roots and bark possess fertility reducing properties. Combining **Moringa** with other medicines maymimic the same effects, as it can add to effects such as blood sugar or blood pressure reducers. Being rich source of iron, avoid overdosing on this mineral.High doses of Moringa can have a laxative effect like any supplement.Too much use of Moringa powder disrupt human digestive system.

METHODS OF APPLICATION TECHNIQUE

Moringa leaves are dried and ground as a powder or as supplements which can be added to smoothies or soups, or it is used as tea. It has mild asparagus-like flavorin taste.This powder can be used**in morning** with 1/2 to 1 Tablespoon of daily.

For cosmetic uses, creams or oils containing **Moringa** seeds or **Moringa** oil can be great additions to beauty routine. Organic and cold-pressed M**oringa** oil is highly resistant to oxidation, avoiding rancid effect before use.

CONCLUSION

Along with superfood fame and its incredible nutrient density,in therapeutic uses, plant possess antimicrobial, anti-inflammatory, and antioxidant compounds which help to protect performance and strengthen body against a wide variety of disease.The herb gets its super food status from a rich nutrition profile, providing more nutrients per gram than many other plant species.with more vitamin C than oranges, more vitamin A than carrots, more potassium than bananas, and more iron than spinach. Moringa is also high in protein, and contains an impressive 8 of the 9 essential amino acids. The nutrient density depends on growing conditions and preparation of Moringa plant cultivation.

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EFFECT OF BOTANICALS ON PENETRATION AND POPULATION OF MELOIDOGYNEGRAMINICOLAJ2 IN THE ROOTS OF RICE

Sobita Simon[1], Amit Kumar Maurya[2],Abhilasha A. Lal[3] and Veeru Prakash[4]

[123]Department of Plant Pathology

[4]Department of Biochemistry and Biochemical Engineering

Sam Higginbottom University of Agriculture, Technology and Sciences,

Prayagraj - 211 007, (U.P.), India

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ABSTRACT

***Meloidogyne graminicola* is serious nematode pest of rice in eastern Uttar Pradesh; the pest is associated during the seedling stage of rice in nursery and cause severe damage and high yield losses in susceptible varieties like Pant12. This nematode completes one life cycle during seedlings stage of paddy within 20 days at 27-37 °C. It indicates that nematode completes many generations in one crop season. The characteristic infection symptoms produced by *M. graminicola* are in the form of terminal hook shaped or spiral galls. Second stage juveniles enter the roots through root tips and start feeding. Nineteen selected plant leaves *viz.* Madar (*Calotropis procera*), Barseem (*Trifolium alexandrinum*), Mustard (*Brassica juncea*), Neem (*Azadirachta indica*), Eucalyptus (*Eucalyptus globus*), Bael (*Aegle marmelos*), Ashwagandha (*Withania somnifera*), Kalmegh (*Andrographis paniculata*), Guldaudi (*Chrysanthemum*), Kaner (*Cascabela thevetia*), Lemon (*Citrus limon*), Giloy (*Tinospora cordifolia*), Castor (*Ricinus communis*), Ashoka (*Saraca asoca*), Night jasmine (*Nyctanthes arbor-tristis*), Papaya (*Carica papaya*), Plumeria (*Plumeria rubra*), Jasmine (*Jasminum*) and Peepal (*Ficus religiosa*) were collected from SHUATS campus. After fifteen days of amendment of botanicals, highly susceptible variety of rice, Pant-12 seeds were sown @10 seed/pot. After 60 days of germination plants were uprooted and examined for number of root galls/ plant root system under a stereoscopic binocular microscope. The results indicated that all the botanicals except Madar significantly suppressed the population of *M. graminicola* as compared to the untreated check. Results for the invasion of *M. graminicola* in botanicals at 1, 2, 3 and 4 days after germination, were recorded. It was observed that J_2 entered to the tip of the rice roots. However, till fourth day after germination no nematodes invaded the roots of rice. The penetration, post penetration development and reproduction of *M. graminicola* at 6, 10, 15, 20, 25 and 30 days after germination of rice seedlings were observed after staining the roots of rice. Results were classified in to four stages of development, J_2 vermiform (I stage), female sausage shaped juveniles (II stage), female without eggs (III stage) and female with eggs (IV stage). Female population, number of root knots and the rate of reproduction were high in control (without treatment) as compared to botanical treatments**

Keywords : *Meloidogyne graminicola, Botanicals, Invasion, Penetration, Reproduction*

INTRODUCTION

Rice (*Oryza sativa*) is the only crop grown in all the agro climatic zones from 49° North in Czechoslovakia to 35° South in New South Wales of Australia. It is world's most prominent staple food for more than one-third of the population playing dynamic role in the food economy and is cultivated in 162 mha annually with an annual global production of 646 mt **(FAOSTAT, 2013)**.

In India, production of Rice during 2017-18 (as per 4th Advance Estimates) was estimated at record 112.91 million tonnes. Production of rice has increased by 3.21 million tonnes than the production of 109.70 million tonnes during 2016-17. It is also higher by 6.61 million tonnes than the five years' average production of 106.29 million tones **(Annual Report, 2018-19).**

Root-knot nematodes (*Meloidogyne* spp.) are one of the most economically damaging genera of plantparasitic nematodes on horticultural and field crops in all temperate and tropical areas **(Trudgill and Blok, 2001)**.

In India, *M. graminicola*was earlier found in West Bengal, Orissa, Assam and Kerala. Recently there are also reports of its prevalence from Himachal Pradesh, Jammu & Kashmir, Uttar Pradesh, Haryana, Punjab, Delhi, Tamil Nadu and Karnataka (**Jain *et al.*,2011**).Considering the fact that *M. graminicola*is serious nematode pest of rice of eastern Uttar Pradesh, where it is predominantly used by the farmers, investigation was planned to generate information on its distribution and host range with host reaction on some rice. Moreover rice root nematode completes life cycle in a very fast span, within 15 days at 27-37 °C (**Jaiswal and Singh, 2011**). It indicates that nematode completes many generations in one crop season. However rice root-knot nematode, *M. graminicola is* most distractive pest of rice and reduces crop yield.

Meloidogyne spp. are obligate plant parasites that settle in roots and complete their life cycle by feeding from host cells **(Williamson and Gleason, 2003).** Like other plant and animal parasites, plant-parasitic nematodes develop strategies to invade and colonize their host plants, subvert the host machinery to their own benefit and overcome host defenses **(Haegeman*et al.,* 2012** and **Mitchum*et al.,* 2013)**. *Meloidogyne* spp. (juveniles stage J2) usually enters theplant through the apex and the root elongation zone, and then migrates between plant cells to reach the youngcentral cylinder. Recent genomic data showed that *M.incognita* and *M. hapla* **(Chitwood, 1949)** genomes containa high number of cell wall degrading enzymes, indicating that the nematode may use a combination of mechanical piercing and cell wall softening to enter and migrate into roots **(Abad *et al.*, 2008; Opperman, *et. al.*, 2008; Danchin*et al.,* 2010)**. Once going into the differentiating vascular tissues, juveniles become sedentary and initiate nourishing feeding site originated from few parenchyma cells.

Concomitantly, neighboring cells divide causing roots to form knots or swellings. It has been shown that secretions from the nematode are crucial in establishment of the nourishing feeding site within the host root **(Bellafiore and Briggs, 2010; Rosso*et al.,* 2012 ; Mitchum*et al.,* 2013).** Feeding-site

formation enables the parasites to pump large amounts of nutrient solutions from the plant's vascular system. The nematode then goes through two developmental stages (J3, J4) to finally differentiate into an adult female which will lay eggs and new juveniles arising from these eggs will, in turn, start a new reproduction. Depending on the hostplant and environmental conditions, the cycle lasts 15–45 days **(Triantaphyllou and Hirschmann, 1960; Perryand Moens, 2011)**. It is critical for the nematode to copewith the host immune responses all along the infectionprocess.

MATERIALS AND METHODS

Nineteen selected plant leaves viz. Madar (Calotropis procera), Barseem (Trifolium alexandrinum), Mustard (Brassica juncea), Neem (Azadirachta indica), Eucalyptus (Eucalyptus globus), Bael (Aegle marmelos), Ashwagandha (Withania somnifera), Kalmegh (Andrographis paniculata), Guldaudi (Chrysanthemum), Kaner (Cascabela thevetia), Lemon (Citrus limon), Giloy (Tinospora cordifolia), Castor (Ricinus communis), Ashoka (Saraca asoca), Night jasmine (Nyctanthes arbor-tristis), Papaya (Carica papaya), Plumeria (Plumeria rubra), Jasmine (Jasminum) and Peepal (Ficus religiosa) were collected from SHUATS campus. The leaves were thoroughly washed under tap water, cut into small pieces and grounded in mixy @ w/v i.e. 250 gm of its leaves in 250 ml distilled water. Each grounded botanical, @ 50 ml/pot were amended in to the *M. graminicola* infested soil approx, 3500 J_2/pot filled in 100 plastic pots containing 1 kg soil. Each treatment was replicated 5 times. After fifteen days of amendment of botanicals, highly susceptible variety Pant-12 seeds were sown @10 seed/pot in each plastic pot. After 60 days of germination plants were uprooted and examined for number of root galls/ plant root system under a stereoscopic binocular microscope.

Evaluation of the selected botanical extracts on the invasion, development and reproduction of *Meloidogynegraminicola* in roots of rice seedlings

Ten botanicals out of nineteen were selected after screening on the basis of minimum infestation at invasion, development and reproduction of *Meloidogyne graminicola* at different days after sowing treated seeds of Pant 12 rice variety. The selected plants of the treatments *viz.* T_{18} Jasmine (*Jasminum*), T_{13} Castor (*Ricinus communis),* T_{19} Peepal (*Ficus religiosa)*, T_{14} Ashoka (*Saracaasoca),* T_5 Eucalyptus (*Eucalyptus globus),* T_4 Neem (*Azadirachta indica),* T_{17}Plumeria (*Plumeria rubra)*, T_{12} Giloy (*Tinospora cordifolia),* T_9Guldaudi (*Chrysanthemum*) and T_8 Kalmegh (*Andrographis paniculata*) were air dried @ 100g of each plant leaves and further grounded with the help of pestle and mortar w/v at ratio 1:1. The extracts were centrifuged at 3000 rpm. The seeds of Pant12 were soaked in the selected plant extract for 24 hrs. After 24 hrs the seeds were sown on 29th July 2019 in the different trays having infested soil of *Meloidogyne graminicola* @ approximately 4000 J_2/Kg soil. Observations were recorded at 1, 2, 3 and 4 days after germination for invasion of *Meloidogyne graminicola* to the rice root.

For development and reproduction an experiment was conducted to check penetration and post-penetration stages of *Meloidogyne*

graminicola. This experiment was arranged in a completely randomized design (CRD) and replicated four times per sampling date. Roots were uprooted at 6, 10, 15, 20, 25 and 30 days after germination of rice.

The infested roots of rice were stained with acid-fuschin method adopted by **Byrd *et al*. (1983).** The roots of rice were uprooted and rinsed under the tap water and placed in a 150 ml beaker. The clean roots were soaked in chlorine bleach @ 5.25% NaOCl with 50 ml of tap water for 4 minutes.

Rinsed the roots with running water for about 45 seconds and then immersed them in water for 15 minutes to remove any residue of NaOCl which may affect staining with acid fuschin. Drained the water and transferred the roots to a glass beaker with 30-50 ml of tap water. Added 1ml of stock acid-fuschin solution stain solution to the water and boil for about 30 seconds in a microwave oven. Stock acid-fuschin solutions were prepared by dissolving 3.5 g acid-fuschin in 250 ml acetic acid and 750 ml distilled water. Cooled the solution at room temperature, drained the stain solution, and rinsed the roots in running tap water.

Destained the roots by boiling in 20-30 ml of glycerin acidified with a few drops of 5 NaHCl.Distributed the roots in a small amount of glycerin on a Petri dish cover, gently pressed against the cover with a Petri dish bottom and observed under a dissecting microscope. Pair of glass plates were used instead of Petri dishes. Roots were stored in acidified glycerin with little loss of contrast between nematodes and roots.

Results for the invasion of *M. graminicola* in botanicals at 1, 2, 3 and 4 days after germination, were recorded and from the stained roots it was observed that on third day after germination in untreated control J_2 entered to the tip of the rice roots. However, till fourth day after germination no nematodes invaded the roots of rice.

The penetration, post penetration development and reproduction of *M. graminicola* at 6, 10, 15, 20, 25 and 30 days after germination of rice seedlings were observed after staining the roots of rice. Results were classified in to four stages of development, J_2 vermiform (I stage), female sausage shaped juveniles (IIstage), female without eggs (III stage) and female with eggs (IV stage)(Plate 9). Female population, number of root knots and the rate of reproduction were high in control (without treatment) as compared to botanical treatments.

RESULTS AND DISCUSSION

Results of selected botanical extracts against root knot nematode (*Meloidogyne graminicola)* in rice seedlings at 60 DAS is presented in Table 1 and Fig. 1. The results indicate that all the botanicals except T_1 (Madar) significantly suppressed the population of *M.graminicola* as compared to the untreated check (T_0). Among the treatments (T_{18}, T_{13}, T_{19}, T_{14}, T_5, T_4, T_{17}, T_{12}, T_9, T_8) were found non-significant to each other but recorded significantly reduced number of galls as compared to (T_{11}, T_{1o}, T_7, T_{15}, T_7, T_3, T_2, T_{16}) and T_1. Among the treatments (T_0, T_1), (T_{16}, T_2, T_3), (T_6, T_{15}, T_{17}, T_{10} and T_{11}), were found non-significant to each other. Treatments (T_3, T_2 and T_{16}) significantly reduced from T_0 (control). The similar results werereported by **Hussain*et al*., (2011).**

Hatching of Egg and mortality test:

Table : 1 - Effect of selected botanical extracts against root knot nematode (*Meloidogyne graminicola*) in rice seedlings at 60 DAS

S.N.	Treatments	R_1	R_2	R_3	R_4	R_5	Mean of root galls/plant
T0	Control	12	13	18	10	15	14
T1	Madar (*Calotropisprocera)*	13	16	13	13	11	13
T2	Barseem (*Trifoliumalexandrinum)*	11	11	9	10	11	10
T3	Mustard (*Brassica juncea)*	13	12	11	9	6	10
T4	Neem (*Azadirachtaindica)*	2	4	2	4	3	3.
T5	Eucalyptus (*Eucalyptus globus)*	2	3	2	4	2	3
T6	Bael (*Aeglemarmelos)*	8	6	9	4	8	7
T7	Ashwagandha (*Withaniasomnifera)*	6	4	9	5	5	6
T8	Kalmegh (*Andrographispaniculata)*	6	4	2	5	2	4
T9	Guldaudi (*Chrysanthemum)*	6	2	3	3	4	4
T10	Kaner (*Cascabelathevetia)*	4	7	6	5	5	5
T11	Lemon leaf (*Citrus limon)*	6	4	7	4	5	5
T12	Giloy (*Tinosporacordifolia)*	2	4	2	6	4	4
T13	Castor (*Ricinuscommunis)*	4	1	2	2	2	2
T14	Ashoka (*Saracaasoca)*	2	4	2	3	2	3
T15	Night jasmine (*Nyctanthesarbor-tristis)*	7	6	9	8	6	7
T16	Papaya (*Carica papaya)*	12	16	8	9	12	11
T17	Plumeria (*Plumeriarubra)*	6	4	3	4	2	4
T18	Jasmine (*Jasminum*)	2	3	2	2	2	2
T19	Peepal (*Ficusreligiosa)*	2	2	2	4	3	3
CD @ 5%							**2.16**
SE(d)							**1.08**

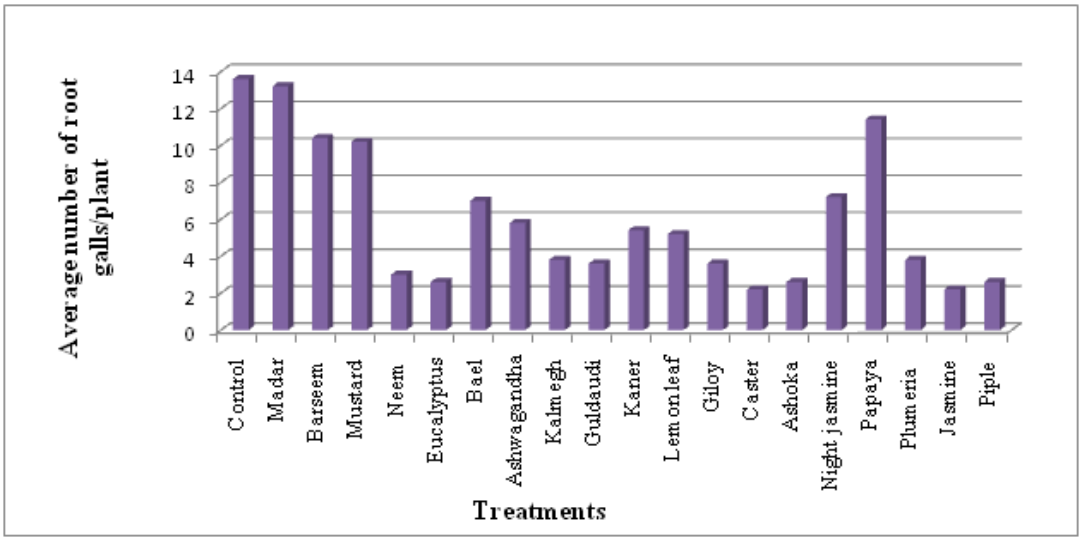

Fig.1. Effect of selected botanical extracts against root knot nematode (*Meloidogyne graminicola)* in rice seedlings at 60 DAS

To screen the botanicals (leaf and seeds extract) for nematicidal activity on *M. graminicola* larvae mortality and hatching of juveniles (J_2) from eggs and mortality test was carried out. The observations were recorded in Table 2 and Fig. 2 for hatching of juveniles from eggs of *M. graminicola* at different days of intervals *i.e*zero days, 24 hrs, 48 hrs and 72 hrs after exposure of eggs in the botanicals.

Data presented in table 2 reveals that minimum hatching of juveniles was recorded in Kalmegh and Eucalyptus (3) followed by Castor (5), Peepal (5); Neem (6), Gulgaudi (6), Jasmine (6), Bael (6); Ashoka (8); Barseem (9), Lemon (9); Papaya (10); Mustard (18); Madar (26) as compared to control (47) at 24 hrs intervals.

At 48 hrs of interval minimum hatching of juveniles was recorded in Kalmegh (3) and Eucalyptus (3) followed by Castor (8), Peepal (8), Neem (8), Jasmine (8), Bael (8); Ashoka (12), Barseem (12); Guldaudi (13); Lemon (15); Papaya (18); Mustard (27); Madar (41) as compared to control (65).

Whereas at 72 hrs of interval minimum hatching of juveniles was recorded in Kalmegh, Eucalyptus (3); Guldaudi (7); Neem (8); Castor (10), Peepal (10), Jasmine (10), Bael (10); Ashoka(15); barseem (18), Lemon (18); Papaya (26); Mustard (34); Madar (45) as compared to control (82).

The data presented in Table 3 and Fig. 3 reveals the effect of botanical extract on juveniles of *M. graminicola* after different days of exposure *i.e* 24, 48 and 72 hrs. The results showsthat the number of dead larvae of *M. graminicola* at different hrs of intervals was maximum in T5 Kalmegh (17, 25 and 30 larvae at 24, 48 and 72 hrs) of exposure, respectively followed by Guldaudi and Neem.Plant extracts have been used for controlling plant parasitic nematodes **Satyal*et al*., (2012)**. Similar findings have been reported by **Dongre and Simon (2013). Joymati, (2009)** reported 1 ppm concentration of *M. azedarach*extract caused mortality more than 60% on juveniles of *M. incognita* within 24 hrs. Chedekal, **(2013)** tested egg-masses and 2nd stage juveniles of *Meloidogyne incognita* in four plant extracts *viz., Calotropis procera*, *Azadirachta indica*, *Clerodendrum inerme* and *Lantana camara*. The maximum reduction % of hatching of egg-masses were found in *Calotropis procera* (99.83%) and the least in *Lantana camara* (77.88%). Maximum mortality of 2nd stage juveniles were recorded in *Azadirachta indica* (90.17%) and least in *Calotropis procera* (60.33%).

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Table : 2 - Effect of leaf extract of botanicals on hatching of *Meloidogynegraminicola*juveniles from eggs

Treatments	Eggs at zero days	Hatching of Juveniles at 24 hrs	% hatching of Juveniles over control	Hatching of Juveniles at 48 hrs	% hatching of Juveniles over control	Hatching of Juveniles at 72 hrs	% hatching of Juveniles over control
T_0 Control	105	47	------	65	------	82	------
T_1 Castor	96	5	10.63	8	12.30	10	12.19
T_2 Peepal	99	5	10.63	8	12.30	10	12.19
T_3 Neem	107	6	12.76	8	12.30	8	9.75
T_4 Guldaudi	101	6	12.76	13	20.00	17	20.73
T_5 Kalmegh	100	3	6.38	3	4.61	3	3.65
T_6 Ashoka	110	8	17.02	12	18.46	15	18.75
T_7 Jasmine	100	6	12.76	8	12.30	10	12.19
T_8 Mustard	97	18	38.29	27	41.53	34	41.46
T_9 Bael	144	6	12.76	8	12.30	10	12.19
T_{10} Eucalyptus	100	3	6.38	3	4.61	3	3.65
T_{11} Madar	96	26	55.31	41	63.07	45	54.87
T_{12} Barseem	90	9	19.14	12	18.46	18	21.95
T_{13} Papaya	100	10	21.27	18	27.69	26	31.70
T_{14} Lemon	103	9	19.14	15	23.07	18	21.95
SEd (±)		**1.84**		**2.00**		**2.39**	
CD (P= 0.05)		**3.94**		**4.28**		**5.11**	

Table : 3 - Effect of botanical extracts on the dead larvae and Mortality percentage of *Meloidogynegraminicola*at different hrs of intervals

Treatments	Larvae at zero days	No. of dead larvae at 24 hrs	% Mortality over control	No. of dead larvae at 48 hrs	% Mortality over control	No. of dead larvae at 72 hrs	% Mortality over control
T_0 Control	47	0	------	0	------	0	------
T_1 Castor	29	7	13.72	9	20.45	11	22.91
T_2 Peepal	34	7	13.72	10	22.72	12	25
T_3 Neem	37	6	11.76	16	36.36	19	39.58
T_4 Guldaudi	33	11	21.56	17	38.63	20	41.66
T_5 Kalmegh	34	17	33.33	25	56.81	30	62.5
T_6 Ashoka	46	3	5.88	3	6.81	5	10.41
T_7 Jasmine	35	1	1.96	2	4.54	3	6.25
T_8 Mustard	35	5	9.80	7	15.90	13	27.08
T_9 Bael	37	3	5.88	5	11.36	9	18.75
T_{10} Eucalyptus	32	9	17.64	12	27.27	22	45.83
T_{11} Madar	35	2	3.92	4	9.09	5	10.41
T_{12} Barseem	40	6	11.76	10	22.72	16	33.33
T_{13} Papaya	39	4	7.84	6	13.63	10	20.83
T_{14} Lemon	39	6	11.76	12	27.27	21	43.75
SEd (±)		**0.98**		**0.98**		**1.07**	
CD (P= 0.05)		**2.02**		**2.02**		**2.20**	

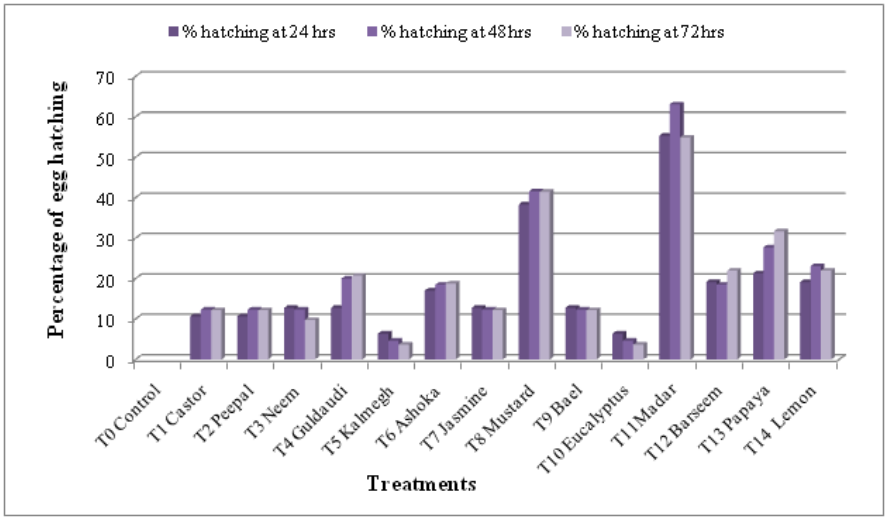

Fig. 2. Effect of leaf extracts of botanicals on hatching of *Meloidogynegraminicola*juveniles from eggs

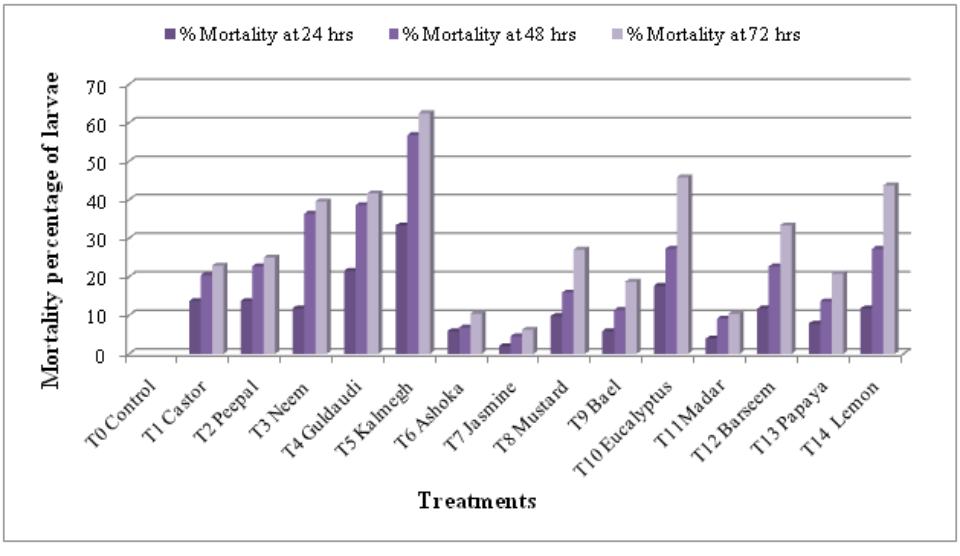

Fig. 3. Effect of botanical extracts on the dead larvae and Mortality percentage of *Meloidogynegraminicola*at different hrs of intervals

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Declaration: I hereby declare that the Information furnished above is true to the best of my knowledge and belief and I am abiding by the rules of the Society of Biological Sciences and Rural Development, Allahabad.

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