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RESEARCH ARTICLE

Influence of organic, inorganic and biofertilizers on physical and biochemical parameters of Vigna unguiculata.

Rabia Badar[1], Hafsa Malik[2], Asif Ilyas[3]

1. Associate Professor,Department of Botany,Jinnah university for Women,Nazimabad,Karachi-74600,Pakistan
2. M.Sc.Student, Department of Botany,Jinnah university for Women,Nazimabad,Karachi-74600,Pakistan
3. MS Student, Department of Economics, University of Peshawar, Pakistan.

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Corresponding Author

Rabia Badar

Abstract

The present study observed the outcome of organic, chemical fertilizer and biofertilizers on growth and biochemical parameters of Vigna unguiculata**.** Result indicated significant improvement in growth and biochemical parameters of plants as compared to control plants. Both biofertilizers JUR2 and JUF2 were found effective in improving the physical and biochemical parameters of Vigna unguiculata . In organic fertilizers farm yard manure indicated best results. DAP as chemical fertilizer only promoted the biochemical parameters of experimental plants. Study showed that biofertilizers may boost the soil fertility by improving its organic and inorganic content. Therefore, biofertilizers could be a good replacement of chemical fertilizer for improving the growth of Vigna unguiculata.

INTRODUCTION

Soil quality is of essential importance for farming production, and soil fertility managing is increasingly becoming a vital topic in the assessments on food safety, poverty decline and environment management. Numerous factors associated to soil fertility limit agricultural production. Soil form, farmer's practices, crop residues and mineral fertilizers organization are those factors which manipulate crop yields (Bationo et al., 2012). Along with those factors, a major limitation to crop production in huge scale is the texture and the chemical composition of soils. Altering the texture through sand modifications increased the bulk densities of the soil (Eugène et al., 2010). Soil organic matter improves the physical, chemical and biological properties of the soil which improve the crop productivity and yield (Micheni et al., 2004).

Organic manures:

Organic farming has great importance globally in view of the growing demand for harmless and healthy food and long term sustainability and concerns on environmental pollution associated with haphazard use of agrochemicals (Mahdi,et al 2010). Organic fertilizers elevate the organic matter in the soil. In turn, organic matter discharges the plant food in obtainable form for the utilization of crops. They provide organic acids that facilitate dissolve soil nutrients and make them available for the plants.

Reduction of soil fertility is a main limitation for higher crop production in Pakistan. Most of the cultivated soils have organic matter of below 1.5 % and on the other hand, addition of organic matter is extremely short. Therefore slight or no accumulation of organic matter occurs in soil (Madukwe et al., 2008). A appropriate arrangement of organic and inorganic sources of nutrients is necessary for sustainable crop yields. Owing to the intensifying price of chemical fertilizers and elevated requirement for eminence and pure foodstuffs the utilization of organic

amendments in agriculture has enhanced over the years (Sangakkara , 1993). Organic manure is a vital resource of raw or incompletely decayed organic matter which improves soil tilt, penetration velocity and soil water holding capacity to give nutrient to the crop (Alijanpour,et al., 2014).Organic manures include (i) Farmyard manure (FYM), (ii) Compost, (iii) Green manure, (iv) Vermicompost.

Biofertilizers:
Biofertilizer is a natural product carrying living microbes resulting from the root or cultivated soil. They also aid in stimulating the plant growth hormones providing better nutrient uptake and improved tolerance towards drought and moisture stress. These microbes are potential tools for sustainable agriculture and a trend for the future (Toyota & Watanabe, 2013).

Chemical fertilizers:
The farmers utilize chemical fertilizers as a supplemental source of nutrients but they do not apply in reasonable quantity (Islam et al., 2011). Even with balanced use of only chemical fertilizer, high yield level could not be maintained over the years because of decline in soil physical and biological environments.

Vigna unguiculata:
Cowpea (*Vigna unguiculata* L. (Walp.) is a leguminous herbaceous warm-season annual crop. Cowpea an annual legume is also commonly referred to as southern pea, black eye pea, lubia, (Fatahi,2014).Cowpea is a drought tolerant crop and better adapted to sandy soil (Rachie and Roberts; 1974). It is mainly used on a grain crop, animal fodder or on a vegetable. Its decaying shoot and root residues contributing to soil fertility (Karanja et al., 2013).

Materials & methods

Collection of root samples for isolation of fungi and rhizobial isolates:
The root samples of plants collected from different places of Karachi. Collected root samples of plants were used to isolate test fungus from rhizoplane and rhizobial cultures by crushed-nodule method by using standard method (Aneja, 1993).

Preparation of conidial and cell inoculums of test fungus and *rhizobial isolates:*

Conidial and cell inoculums of *T.hamatum* and *Rhizobial isolates* were prepared for conducting pot experiments to investigate the effect of microbial inoculants on growth and biochemical parameters of two experimental plants after calculating number of conidia per ml or colony forming unit (cfu) per ml and adjusted the concentration about 10^5-10^6 cfu/mL with help of SMIC haemocytometer ART. No.1280. Similar procedure was used to prepare cell inoculum of *rhizobial* isolates, calculated and adjusted to 10^7-10^8 cfu/ml cfu/mL (Badar and Qureshi, 2012).

Experimental procedures:

Five experimental treatments were used for experimental plants. Each experimental pot was initially supplied with the treatments given in table, 1 and then followed by tap water irrigation. Three replicate were used for each treatment. Complete randomized design was applied for experimental purpose. After 30 days plants from each treatment replicated were plugged out and analyzed their physical (no. of nodules, root & shoot length, fresh& dry plants weight) and biochemical analysis. Following biochemical processes were used for study.

Bio-chemical parameters of experimental plants:
An Anthrone method (Yemm and Willis, 1956) was used to determine total carbohydrate (mg/g). Total protein by Lowry's method (Lowry et al., 1951) and total phosphorus by Barton's reagent (Ashraf et al., 1992).

Analysis of data:
Results of present pot experiments are expressed as mean ± standard deviation (SD). The data was analyzed by using *One-way* ANOVA followed by LSD test through SPSS 16 (version 4). The differences were considered significant at $p<0.05$ when treatments' mean compared with control.

Results

Growth parameters:

Nodules were one of the parameter used to acess the effect of different types of fertilizers supplied to the experimental plants. Measured by counting nodules on each plant. Result showed the effect of JUR2 was more beneficial and promotory role in the growth of nodules as compared to control. Fig: 1 showed that PM and JUF2 showed significant effect as compared to control and favored production of nodules. While treatment supplied with FYM and DAP as compared to control also promoted the Nodules production.

Results in fig: 2 showed that response was more effective and promotory in JUF2. Other treatments also increased root length as compared to the control. Fig: 3 showed that all treatments increased the root fresh weight except the poultry manure. Maximum weight obtains by JUR2 which increased the 80% weight as compared to the control. Only JUR2 and JUF2 gave positive result (fig: 4) and increased the dry matter upto 30%.Growth of cowpea plants was observed after 30 days treated with different fertilizers. Fig: 5 showed that the effect of both biofertilizers was more positive on length of cowpea plants. Maximum elongation obtains by JUR2 which is 103.62% as compared to the control.

All treatments were beneficial to increased the fresh weight of cowpea plants as compare to the control after 30 days of growth except PM. JUR2 increased maximum fresh weight (fig: 6) which is 102% as compared to the control while FYM and DAP increased the fresh weight upto 44 and 59% as compared to the control .Dry weight of cowpea plants after 30 days increased by all the treatments except PM as compared to the control. JUR2 significantly increased the shoot dry matter as compared to the control (fig: 7).

Biochemical parameters

All treatments significantly enhanced carbohydrate content as compared with control after 30 days growth in cowpea plants(fig:8). JUR2 increased maximum carbohydrate content upto 300% while FYM upto 135%. While PM and JUF2 gave more aur less similar results in cowpea plants upto 118%. DAP also increased carbohydrate content upto 100%.

In Fig: 9 PM and JUF2 significantly increased the protein content of cowpea plants after 30 days growth. All other treatments also increased protein content of experimental plants.

Results of fig: 10 showed that all treatments enhanced the Phosphorus content of cowpea plants.PM, DAP and JUR2 significantly increased the percent phosphorus content as 246%, 400% and 297% respectively after 30 days of growth in experimental plants as compare to control.

Table :1 Treatments with their code and amounts.

S.no	Treatments	Code	Amount
1	Tap water	CONT.	
2	Farm yard manure	FYM	10 tons/ha
3	Poultry manure	PM	10 tons/ha
4	Diammonium phosphate	DAP	60 kg/ha
5	Bradyrhizobia sp.	JUR2	10^7-10^8 cfu/ml
6	Trichoderma sp.	JUF2	10^5-10^6 cfu/ml

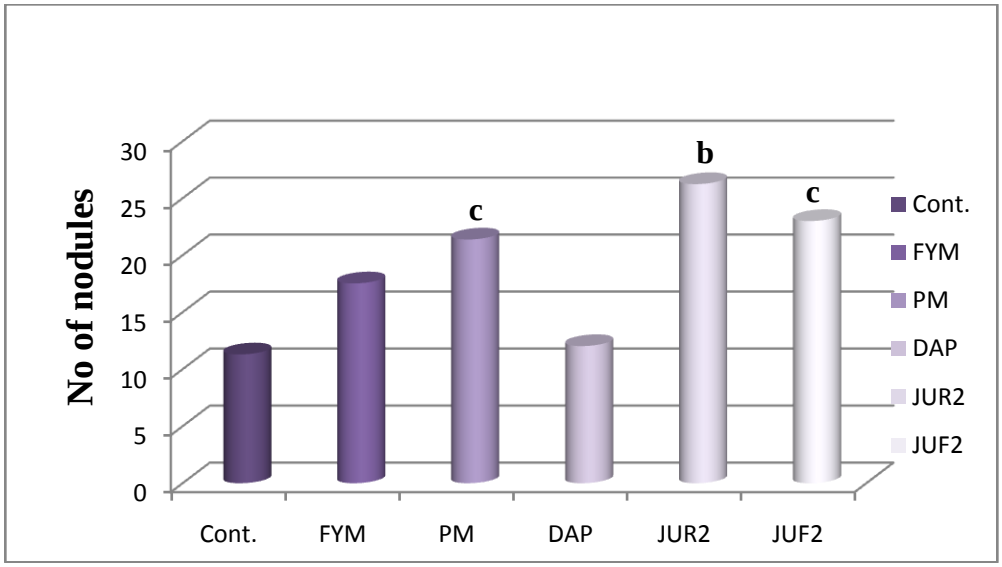

Figure 1: Influence of organic, inorganic and biofertilizers on no of nodules of *Vigna unguiculata*. Different letters at columns show significant difference (P < 0.05 LSD) between treatments.

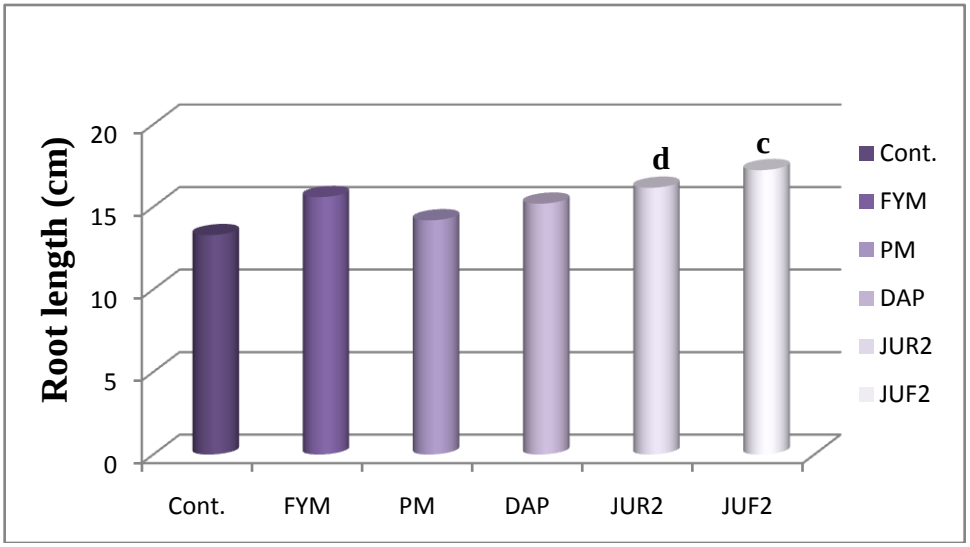

Figure 2: Influence of organic, inorganic and biofertilizers on root length of *Vigna unguiculata*. Different letters at columns show significant difference (P < 0.05 LSD) between treatments.

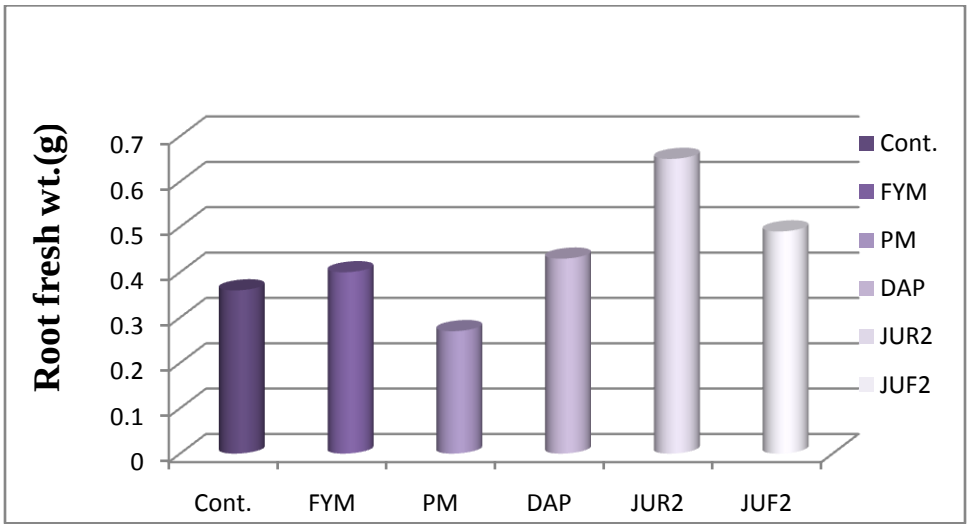

Figure 3: Influence of organic, inorganic and biofertilizers on Root fresh weight of *Vigna unguiculata*. . Different letters at columns show significant difference (P < 0.05 LSD) between treatments.

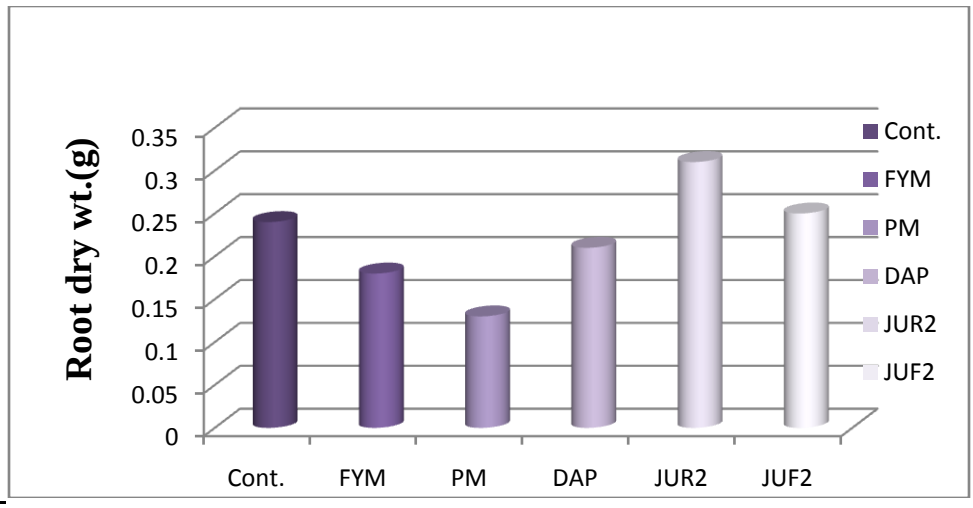

Figure 4: Influence of organic, inorganic and biofertilizers on Root dry weight of *Vigna unguiculata*. . Different letters at columns show significant difference (P < 0.05 LSD) between treatments.

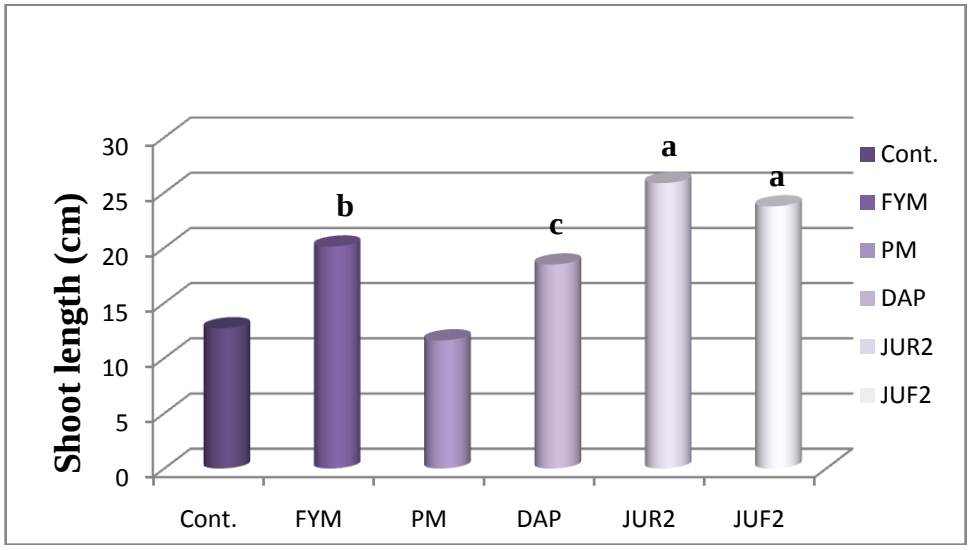

Figure 5: Influence of organic, inorganic and biofertilizers on Shoot length of *Vigna unguiculata*. Different letters at columns show significant difference (P < 0.05 LSD) between treatments.

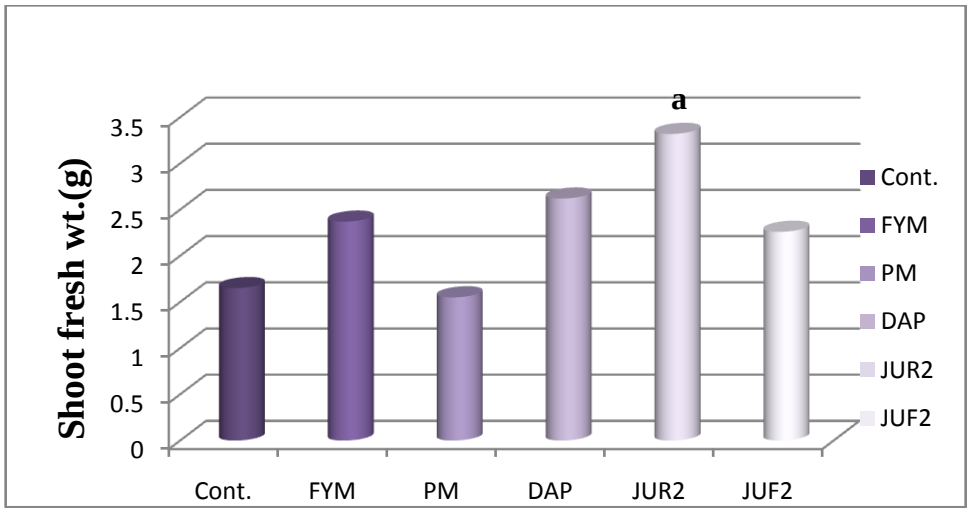

Figure 6: Influence of organic, inorganic and biofertilizers on Shoot fresh weight of *Vigna unguiculata*. Different letters at columns show significant difference (P < 0.05 LSD) between treatments.

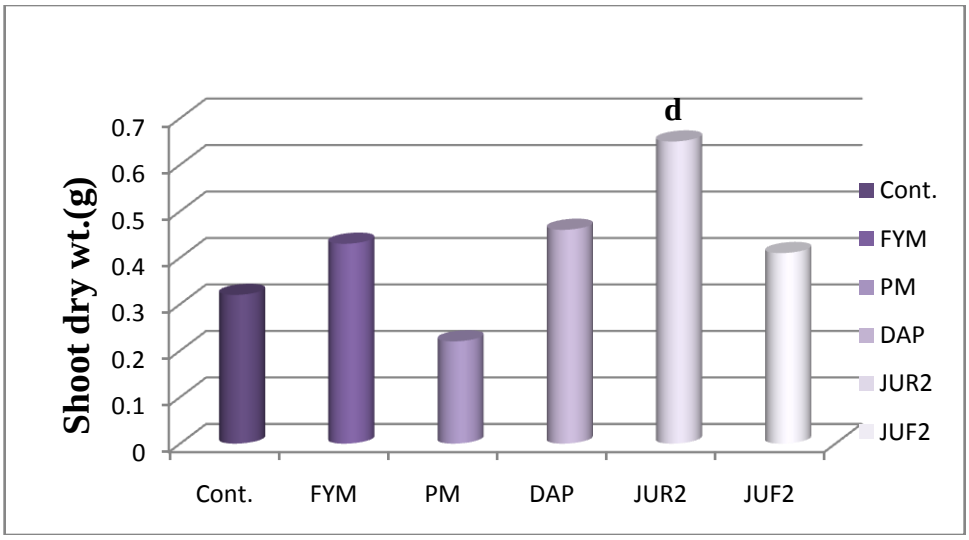

Figure 7: Influence of organic, inorganic and biofertilizers on Shoot dry weight of *Vigna unguiculata*. Different letters at columns show significant difference (P < 0.05 LSD) between treatments.

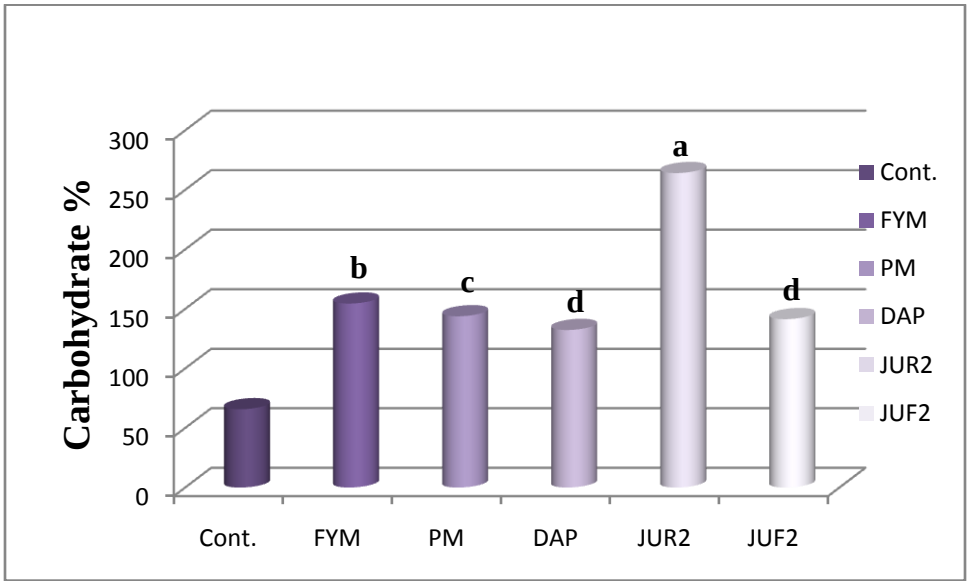

Figure 8: Influence of organic, inorganic and biofertilizers on Carbohydrate content of *Vigna unguiculata*. Different letters at columns show significant difference (P < 0.05 LSD) between treatments.

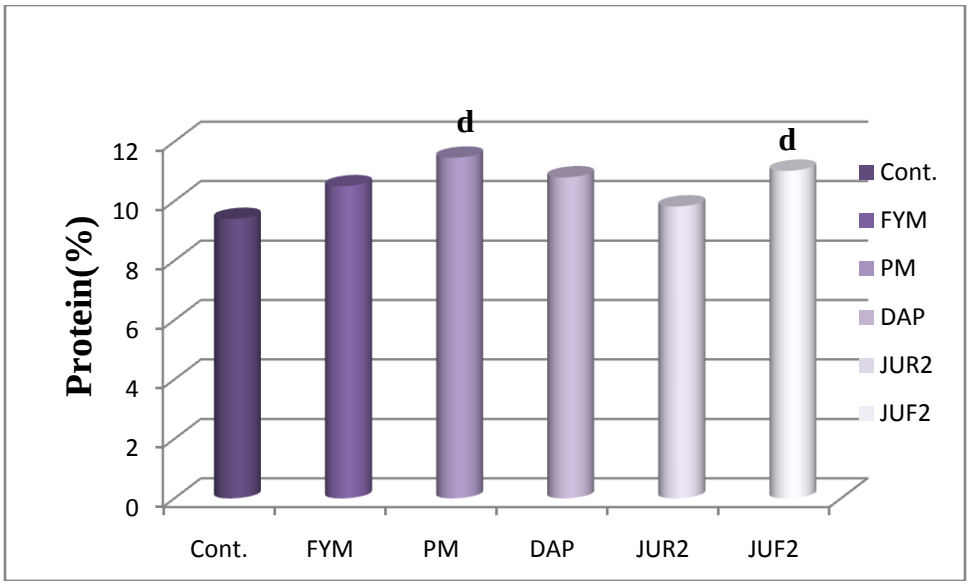

Figure 9: Influence of organic, inorganic and biofertilizers on Protein content of *Vigna unguiculata*. Different letters at columns show significant difference (P < 0.05 LSD) between treatments.

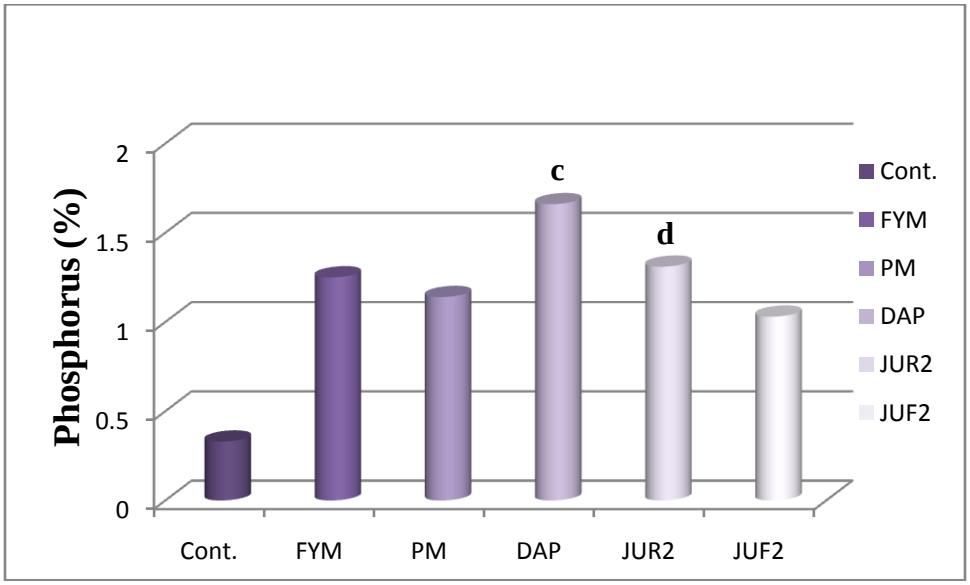

Figure 10: Influence of organic, inorganic and biofertilizers on Phosphorus content of *Vigna unguiculata*. Different letters at columns show significant difference (P < 0.05 LSD) between treatments.

Discussion

Soil fertility and productivity is maintained by Soil organic matter. Organic matter acts directly as a source of plant nutrients and indirectly influences the physical and chemical properties. Agricultural practices which involve heavy application of chemical fertilizers may cause depletion of certain nutrients in soil and nutrient disparity which affects the soil productivity. The integration of bio-fertilizers plays most important role in improving soil fertility, yield attributing characters and in that way final yield has been reported by many workers (Kachroo and Razdan, 2006; Son *et al.* 2007).

Result showed the effect of JUR2 and JUF2 was more beneficial and promotory in the growth of nodules as compared to control. The increased nodulation, N fixation and yield of legume crops following inoculation with biofertilizers have been reported by many workers (Venkatashwarlu, 2008; Bhat et al.,2010). Treatments with pure cultures of *Rhizobium* significantly increased the number of nodules. It has already been reported by Hunter *et al.1994.* It has been observed in many experiments that by using *rhizobium* inoculants with and without fertilizer increased number of nodules and yield of different crops. (Mia & Shamsuddin, 2010). Organic manures also produced the significant effect on the production of more nodules in cowpea plants. This agreed with the findings of Madukwe et al., 2008 the maximum quantity of nodules (15.9) was observed from plots that received poultry manure treatment as compared with untreated plots.

All treatments increased the root length but biofertilizers significantly increased the root length of experimental plants. Yamada et al., in 1997 stated that most obvious effect of EM application is root development and root growth. Yedidia *et al*. 2001 stated that *Trichoderma* spp increase the uptake and concentration of a variety of nutrients in roots of cucumber plants even under axenic conditions. *T. harzianum* strain T22, boost root enlargement of a variety of plants. (*Aisha ,2013).*Root fresh and dry weight of cowpea plants were increased with the application of biofertilizers as JUR2 and JUF2.(Badar and Qureshi ,2012)

Biofertilizers increased the shoot length of experimental plants more significantly .Only rhizobial inoculants (JUR2) significantly increased the fresh and dry weight of cowpea plants (Badar and Qureshi , 2012). Solaiman et al., 2010 and Lamptey et al., 2014 showed that Rhizobium inoculant significantly increased shoot dry weight of chickpea compared to uninoculated control. According to findings of Kolawole et al., 2010 P sources on the average, increased shoot dry weight of cowpea. *Rhizobia* are reported to produce various metabolites such as cytokinins, riboflavin, vitamins, etc and their invasion in roots of legume and non-legume plants, not only promotes an increase in plant growth but also significantly improves the plant health (Matiru & Dakora,2004). Similarly diazotrophic *rhizobacteria* also increase the vegetative growth of crop plants by interacting with their roots (Riggs et al.,2001).The *Trichoderma* genus is reported to improve the growth of plants, increasing the half-life of seedling, plant height and weight and leaf area, etc .These beneficial effects on plant growth in the existence of *Trichoderma* inoculants are reported due to the enhancement in mineral uptake, decomposing organic matter, production of plant hormones, enzymes and antibiotics, etc .(Mishra,1996).Both organic and biofertilizers increased maximum content of carbohydrate in experimental plants (Badar et.al, 2014).
Magani, I.E. And Kuchinda, C. reported in 2009 that the clear response to Phosphorus utilization observed in terms of growth and protein content of the two varieties confirms that P is an vital nutrient element affecting the yield of cowpea. Similar results were obtained when treatment supplied with PM and JUF2 which significantly increased the protein content as compared to control. All treatments increased the phosphorus content of cowpea plants. Tagoe, et al., reported in 2008 that Plant total P content of cowpea was affected by both carbonized organic amendment and chemical fertilizer application.

Conclusion

Organic agriculture encourages vigorous practices management of soil and atmosphere avoiding chemical pollution, by chemical fertilizers. It decreases the entry of toxic residues into the soil in that way promoting production of fresh, quality foods. Therefore the importance is at the present is on organic farming.

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