IMPACT OF DIFFERENT NUTRIENT SOURCE ON YIELD AND SOIL PROPERTIESOF BLACK GRAM (*Vigna mungo* L. HEPPER) UNDER ORGANIC FARMING

ABSTRACT

The field investigation was conducted on Black gram *cv*. GU 3 at Organic Farm, ACH, N.A.U., Navsari during summer 2021. The experiment was laid out in Randomized Block Design with Factorial concept (FRBD) comprisingof two factors each having three levels *i*. *e*. soil application *viz*., S_1 (100 % RDN through NADEP compost), S_2 (Ghan-jivamrut @ 500 kg/ha) and S_3 (Ghan-jivamrut @ 500 kg/ha + Jivamrut @ 500 l/ha) and foliar application *viz*., F_0 (Control), F_1 (Novel organic liquid nutrient @ 1 %) and F_2 (*Moringa* leaf extract@ 3 %) was given thrice at 15, 30 and 45 DAS. The result revealed that S_1 treatment significantly recorded the seed yield. While for foliar application, the treatment F_2significantly recorded the highest seed yield and stover yield but remained at par with F_1 treatment. It can be determined that the soil application of 100 per cent RDN through NADEP compost and foliar application of either 3 per cent *Moringa* leaf extract or 1 per cent Novel organic liquid nutrient at 15, 30 and 45 DAS resulted in higher yield and also improved the soil properties as compared to the initial status of soil after harvest of black gram under organic farm.

Keywords :: Biofertilizer, Black gram, Ghan-jivamrut, Jivamrut, NADEP compost, Novel organic liquid nutrient, *Moringa* leaf extract, Organic Farming.

1. INTRODUCTION

Black gram (*Vigna Mungo* L. Hepper) commonly known as urd bean, mash bean etc. It belongs to family *Fabeaece* is one of the most important pulse crop grown throughout India. Blackgramis believed to be originated from South Asia, mainly India.It is hardy crop and thrives well in adverse climatic conditions too So it can be grown in all the seasons. (Anon., 2014). To overcome the problem of food security this would help a lot as it contains 26 % protein which is two to three times of cereal crops. It has unique importance in Ayurveda (Selvakumar *et al.*, 2012). It can be used for various purpose like seed, green manure purpose as well as act as good fodder. It is mainly consumed in form of dal (Ajila and Rao, 2009). Dal in combination with polished white rice are fermented for preparing South Indian cuisine like dosa, idli, *etc.* and used as non-fermented for preparing papad, baris and cooked dal (Senthil *et al.*, 2006). The use of green revolution technology in need of increased demand of food grain has led to overuse of chemical fertilizers leading to deterioration of soil properties. The solution to the problem is organic farming which mainly deals with the use of more on-farm inputs and excludes the use of chemical fertilizers, insecticides, pesticides, etc (Reddy, 2019). Black gram being a legume crop does not require much nitrogen as it has ability to fix atmospheric nitrogen in the soil by the process of biological nitrogen fixation carried out by rhizobia present in root nodules of the plant (Zahran, 1999).Composting is the one of the most effective and beneficial component of organic farming, biological recycling by which waste is converted into organic manure. NADEP compost method. It is a good quality black or brown compost rich in plant nutrients and can easily hold soil moisture (Kumawat *et al*., 2017). The cow based organic manure like jivamrut, bijamrut, panchgavya are being used as good alternative of chemical fertilizer (Kaur, 2020).Biofertilizers are microbial preparations containing efficient strains of beneficial microorganisms which are used for accelerating

certain microbial processes to augment the availability of nutrients in a form that plants can assimilate readily(Anon., 2016). The use of *Moringa* leaf extract as bio-stimulant for foliar spray which has not gained much of popularity is now being focused by the researchers to make its most possible use as is easily available to farmers and can be prepared easily. *Moringa oleifera* is commonly known as the horseradish or drumstick tree(Bhatti *et al.,* 2007). Its leaves have high nutritional and medicinal values, as they are rich in fiber, protein, carbohydrate, essential amino acids, essential minerals, and vitamins (El Sohaimy*et al.,* 2015). Fresh *Moringa oleifera* leaves have been shown to have zeatin, a cytokinin related hormone (Fuglie, 2000). The zeatin is one form of the most common forms of naturally occurring cytokinin in plants which helps to enhance crop growth and yield (Prosecus, 2006). Enriched banana pseudo stem sap is the liquid obtained from banana pseudo-stem while separating fiber the extractant remained. The banana pseudo-stem contained macro elements in the range of 1 - 1.12 per cent N, 0.50 - 0.71 per cent P, 2.39 to 20.2 per cent K and micro-nutrients in the range of 259 to 323.2 mg/kg Fe, 47.3 to 241.3 mg/kg Mn, 10.1 to 107.4 mg/kg Zn and 13.4 to 83.6 mg/kg Cu (Salunke, 2010). The foliar spray of this saphelps to promote crop growth, protect crop from harmful pest and enhances crop yield. A patent product "NOVEL- Liquid Organic Nutrient" has been developed by the Banana Pseudo-stem Processing Unit, Navsari Agricultural University, Navsari, Gujarat. So, use and proper management of organic nutrient for pulse crop is important for creating ecofriendly environment for future generation.

2. MATERIALS AND METHODS

The present research work was carried out at Organic Farm, ASPEE College of Horticulture, Navsari Agricultural University, Navsari during summer season of 2021, in Plot No. F-17, which is geographically situated at the coastal region of South Gujarat at 20º 57′ N latitude and 72º 54′ E longitude with an altitude of 10 m above the mean sea level. The weather conditions during the growing season were normal and favourable for the crop Black gram *cv.* GU 3. The statistical design selected for the experiment was Randomized Block Design with Factorial concept which included two factors *i. e.* soil application and foliar application, each having three levels and replicated three times. The three factors included in soil application were *viz.*,S_1 :100 % RDN through NADEP compost, S_2 :Ghan-jivamrut @ 500 kg/ha and S_3 : Ghan-jivamrut @ 500 kg/ha + Jivamrut @ 500 l/ha. While the other three factors included in foliar application (F) were viz., F_0 : Control, F_1 : Novel organic liquid nutrient @ 1 % and F_2 : *Moringa* leaf extract@ 3 %. Thesoil application of organic sources namely NADEP compost and Ghan-jivamrutwasgivenprior to sowing and single application of jivamrut was done at the time of first irrigation as per the treatments. The foliar applications of liquid organic nutrients was applied at 15, 30 and 45 DAS as per the treatment. Before sowing the seed were inoculated with *Rhizobium* and PSBeach@ 10 ml/kg seed.

2.1 Initial physico-chemical properties of the experimental soil

The representative soil samples of experimental field were drawn from 0-15 cm prior to the application of various treatments as well as after the harvest of the crop for the determination of initial physico-chemical properties of the soil of experimental site. The collected soil samples were oven dried, grinded using the wooden mortar and pestle and then sieved through 2 mm sieve. These sample were further used for the analysis of soil properties. The information regarding the initial physico-chemical properties of the experimental site and the method used for the analysis has been furnished in the Table 1.

Table 1 : Method of analysis of the soil properties

Sr. No.	Particulars	Soil depth (0-15 cm)	Method of analysis	Reference
A)	**Physical Properties of soil**			
1.	Sand (%)	18.50	International Pipette Method	Piper, 1966
2.	Slit (%)	25.00		
3.	Clay (%)	56.50		
4.	Textured Class	Clayey		
B)	**Chemical Properties of soil**			
1.	$pH_{(1:2.5)}$	7.40	Potentiometric	Jackson, 1973
2.	$EC_{(1:2.5)}$ (dS/m)	0.32	EC meter	Jackson, 1973
3.	Organic Carbon (%)	0.81	Walkley and Black Method	Jackson, 1973
4.	Available N (kg/ha)	258.7	Alkaline $KMnO_4$ Method	Subbiah and Asija, 1956
5.	Available P_2O_5 (kg/ha)	56.80	Olsen's Method Extraction with 0.5 M $NaHCO_3$ (pH 8.5) and Spectrophotometric determination	Olsen *et al*., 1954
6.	Available K_2O (kg/ha)	497.52	Flame Photometric Method Extraction with Neutral Normal Ammonium acetate and Flame photometric determination	Jackson, 1973

3. RESULTS AND DISCUSSION

3.1 Seed yield

The seed was calculated on the basis of seed yield obtained from the net plot (kg/plot) and was subjected to statistical analysis. The results obtained have been highlighted in Table 2. An appraisal of seed yield data indicated that soil application of organic nutrient sources and foliar spray of liquid organic sources significantly influenced the seed yield as much variation was observed and showed positive impact on it. The result revealed that the application of 100 per cent RDN through NADEP compost significantly recorded the highest seed yield *i. e.* 1041 kg/ha. While the S_2 treatment where 500 kg/ha Ghan-jivamrut was applied recorded the lowest yield of 836 kg/ha.The foliar spray of 3 per cent *Moringa* leaf extract (F_2 treatment) resulted in significantly higher seed yield (1051 kg/ha) and was statistically similar with foliar spray of 1 per cent Novel organic liquid nutrient (F_1 treatment) which recorded 937 kg/ha seed yield. While the F_0 treatment as control where no foliar application was given recorded the lowest seed yield *i. e.* 805 kg/ha.The reason for the higher seed yield due to *Moringa* leaf extract may be that it increases the loading and unloading of assimilates across membrane boundaries of the vascular tissues leading to increase in yield. Cytokinins present in MLE also promote carbohydrate metabolism and create new source-sink relationships leading to increased yield of crop.The influence of interaction effect of soil and foliar application on the seed yield was found to be statistically non-significant. No variation in seed yield was observed due interaction effect.The previous experiment results noted by Chaudhari (2013) in green gram and Rathva (2013) in pigeon pea, Abohassan and Abusuwar (2017) in green gram, Gunasekar *et al.* (2018), Nivethadevi*et al.* (2021) in black

gram and Irshad *et al.* (2022) in chickpea were found to be closely related with the findings of present research work.

3.2 Stover yield

The stover yield of net plot was noted at the time of harvest which was converted to obtain stover yield on hectare basis. The details regarding the stover yield of black gram have been tabulated in Table 2. From the result obtained it was concluded that the stover yield was significantly influenced by the soil application and foliar application of the organic nutrient sources. The S_1 (100 % RDN through NADEP compost) treatment recorded significantly higher stover yield of2696 kg/ha and it remained at par with S_3 (Ghan-jivamrut @ 500 kg/ha + Jivamrut @500 l/ha) treatment which recorded 2536 kg/ha stover yield.The result revealed that the foliar application of *Moringa* leaf extract @ 3 per cent *viz*., F_2 treatment recorded significantly higher stover yield of 2725 kg/ha but was statistically similar with F_1 treatment where, Novel organic liquid nutrient @ 1 per cent was sprayed and it recorded 2446 kg/ha stover yield. The F_0 treatment, control where no spray was given recorded the lowest 2228 kg/ha stover yield.The statistically non-significant result was obtained for the stover yield due to the interaction effect between the soil and foliar application of various nutrient organic sources.The results of present study are in conformity with the previously reported findings of Chaudhari (2013) in green gram and Rathva (2013) in pigeon pea, Gunasekar *et al.* (2018) in black gram, Nivethadevi*et al.* (2021) in black gram and Irshad *et al*. (2022) in chickpea.

3.3 Harvest index

The harvest index was calculated on the basis of the seed yield and biological yield which was subjected to statistical analysis. The prevailing result have been presented in Table 2. The result indicated that the harvest index did not significantly differ due to the influence of soil application and foliar application of the various organic nutrient sources. Numerically, the S_1 treatment recorded the highest harvest index followed by S_2 and S_3 treatment *i. e*. 28.24 %, 27.82 % and 26.49 %, respectively. While in foliar application, the F_1 treatment (Novel organic liquid nutrient @ 1 %)recorded numerically the highest harvest index of 27.98 per cent in comparison to F_2 treatment and F_0 treatment which recorded 27.83 per cent and 26.75 per cent harvest index, respectively. The harvest index was not significantly inferred due to the interaction between the soil and foliar application of the various organic nutrient sources and the result obtained was statistically non-significant.

3.4 Initial Soil Properties

The soil samples were collected from the experimental field before sowing of the black gram and then the soil properties were analyzed in the laboratory which have been depicted in Table 1. It was observed that the organic carbon content in soil was 0.81 per cent at initial period which indicates medium range of OC content. The available nitrogen was 258.6 kg/ha, available phosphorus was 56.80 kg/ha and the available potassium was 497.52 kg/ha in the soil before the experiment. It can be said that the soil was in medium nitrogen and phosphorus in medium range while the available potassium was high

Table 2 : Effect of different organic nutrient source on yield of Black gram*cv.* GU 3

Treatments	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
Factor I : Soil application (S)			
S_1 - 100 % RDN through NADEP compost	1041	2696	28.24
S_2 - Ghan-jivamrut @ 500 kg/ha	836	2166	27.82
S_3 - Ghan-jivamrut @ 500 kg/ha + Jivamrut @ 500 l/ha	917	2536	26.49
SEm ±	40	123	1.17
CD at 5 %	120	379	NS
Factor II : Foliar application (F)			
F_0 - Control	805	2228	26.75
F_1 - Novel organic liquid nutrient @ 1 %	937	2446	27.98
F_2–*Moringa*leaf extract @ 3%	1051	2725	27.83
SEm ±	40	126	1.17
CD at 5 %	120	379	NS
Interaction			
S×F	NS	NS	NS
CV %	12.89	15.36	12.74

.

3.5 Organic Carbon Content (%)

The details about the organic carbon content in soil after harvest of black gram crop have been furnished in Fig. 1.The mean data of organic carbon content did not show significant difference due to effect of soil application of various treatment.The organic carbon content was numerically higher in S_1 (100 % RDN through NADEP compost)treatment 0.82 per cent followed by S_3*i. e.*Ghan-jivamrut @ 500 kg/ha + Jivamrut @500 l/ha treatment with 0.80 per cent and then S_2*i. e.*Ghan-jivamrut @ 500 kg/ha treatment with 0.79 per cent.The foliar application of the organic sources failed to influence the organic carbon content in the soil and the obtained result was statistically non-significant. Numerically the highest organic carbon content was recorded for the F_1*i. e.*Novel organic liquid nutrient @ 1 % treatment *i. e.* 0.81 per cent.However, both the F_0 and F_2 treatment recorded similar 0.80 per cent organic carbon content. As the experiment was carried out certified organic farm the soil is already rich in organic carbon content and the black gram being pulse crop its duration is only of three months so it can not have drastic change in the soil properties.The interaction effect of soil and foliar application of various organic nutrient sources showed non-significant result for the organic carbon content in soil after harvest.

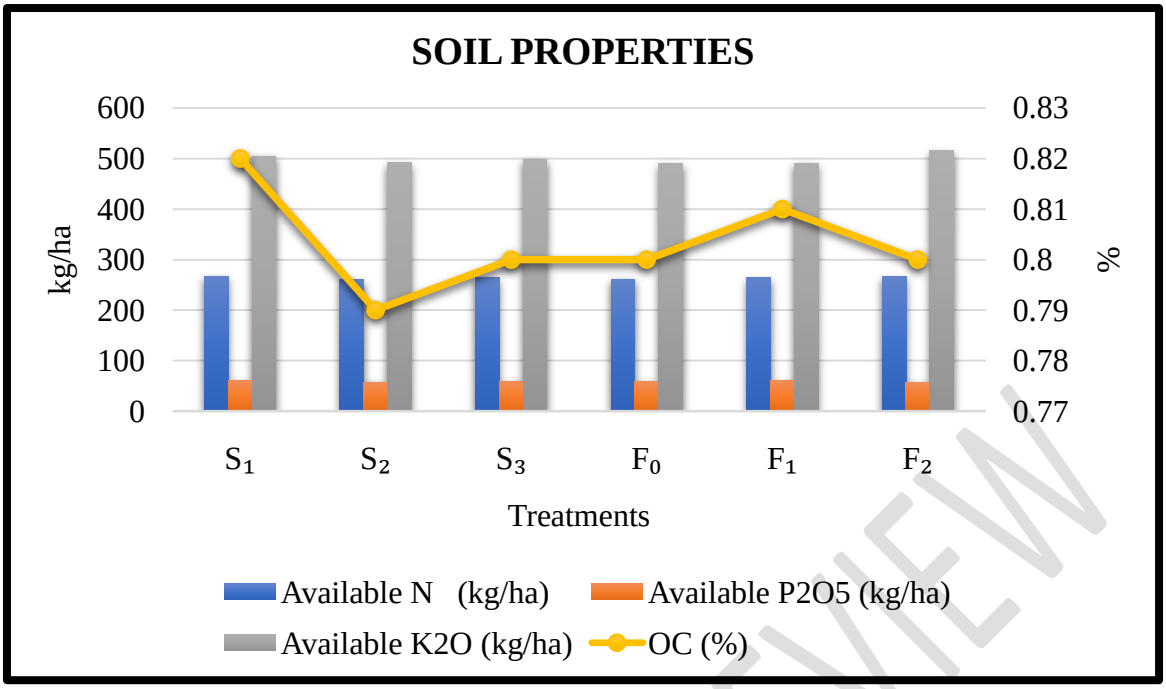

Figure 1: Effect of different treatmentson soil properties after harvest of Black gram

3.6 Available Nitrogen (kg/ha)

The available nitrogen recorded for the different treatments have been tabulated in Fig. 1.The statistically non-significant result was obtained for the available nitrogen assessed after the harvest of black gram. It was noted that S_1 treatment recorded numerically the highest available nitrogen of 267.26 kg/ha while the S_2 treatment recorded the lowest available nitrogen 259.97 kg/ha.Looking at the analyzed data, the available nitrogen in soil did not show any variation due to foliar application of the liquid nutrient sources. Numerically the highest available nitrogen 266.29 kg/ha was noted for the F_2(*Moringa*leaf extract @ 3%) treatment followed by 264.21 kg/ha for the F_1(Novel organic liquid nutrient @ 1 %) treatment.The available nitrogen in the soil after harvest did not significantly differ due to the influence of interaction effect between the soil and foliar application of various nutrient sources.

3.7 Available Phosphorus (kg/ha)

The explicit data of available phosphorus after harvest of black gram have been presented in Fig. 1.The perusal data of available phosphorus indicated that available P_2O_5 was not significantly influence by the soil application of organic nutrient sources. But numerically the highest available phosphorus was observed in S_1 treatment *i. e.* 60.20 kg/ha however, the S_2 treatment noted the least available phosphorus of 57.25 kg/ha.The explicit data of the regarding the influence of the foliar spray of liquid organic sources gave non-significant result for the available phosphorus. The F_1(Novel organic liquid nutrient @ 1 %) treatment numerically recorded the highest 60.16 kg/ha available phosphorus while the F_2(*Moringa*leaf extract @ 3%) treatment recoded the lowest57.50 kg/ha available phosphorus.The interaction between soil and foliar application of various sources showed non-significant result for the available phosphorus in soil after harvest of black gram.

3.8 Available Potassium (kg/ha)

The prevailing data regarding available potassium after the harvest of black gram have been depicted in Fig. 1.On examination ofthe available potassium, it was noticed that no variation was observed in it as the soil application of various organic sources failed to influence the available potassium in soil. The numerically available potassium in soil after

harvest of black gram was noted the highest 504.48 kg/ha for the S_1(100 % RDN through NADEP compost) treatment. In comparison to application of Ghan-jivamrut @ 500 kg/ha (491.62 kg/ha) the combined application of Ghan-jivamrut @ 500 kg/ha + Jivamrut @500 l/ha (498.65 kg/ha) recorded higher available potassium after harvest of black gram. The mean data obtained for the available potassium in soil concluded that the foliar application of the liquid organic sources failed to influence it and result obtained was statistically non-significant. Numerically the available potassium obtained was higher for F_2treatment (514.93 kg/ha) followed by F_1 treatment (490.41 kg/ha) and the F_0 treatment (489.41 kg/ha).The perusal data of the available potassium in soil after harvest of black gram indicated non-significant result due to interaction between the soil and foliar application of the organic nutrient sources.

4. CONCLUSION

Based on the results obtained from the present study, it can be concluded that higher yield and to improvethesoil properties for the summer black gram *cv.* GU 3 can be acquired through soil application of 100 per cent RDN through NADEP compost and foliar application of either 3 per cent *Moringa* leaf extract or 1 per cent Novel organic liquid nutrient at 15, 30 and 45 days after sowing under organic farming.

5. REFERENCE

Abohassan, R. A. and Abusuwar, A. O. (2018). Effects of *Moringa oleifera* leaf extracts on growth and productivity of three leguminous crops. *Legum. Res.Int. J.*, **41** (1): 114-119.

Ajila, C. M. and Rao, U. P. (2009). Purification and characterization of black gram (*Vigna mungo*) husk peroxidase. *J. Mol. Catal. B: Enzymatic*, **60** (1-2): 36-44.

Ajila, C. M. and Rao, U. P. (2009). Purification and characterization of black gram (*Vigna mungo*) husk peroxidase. *J. Mol. Catal. B: Enzymatic*, **60** (1-2): 36-44.

Anonymous (2014). Organic Black gram farming – Production in India. Retrieved from https://www.agrifarming.in/organic-black-gram-farming-production-in-india.

Anonymous(2016). TNAU AGRITECH PORTAL. Retrieved from agritech.tnau.ac.in

Bhatti, H. N.; Mumtaz, B.; Hanif, M. A. and Nadeem, R. (2007). Removal of Zn (II) ions from aqueous solution using *Moringa oleifera* Lam. (Horseradish tree) biomass. *Process Biochem.*, **42** (4): 547-553.

Chaudhari, N. N. (2013). Performance of different organic manures on yield, quality and uptake of nutrients by organically produced mung bean (*Vigna radiata* L.) cv. "Meha". *Thesis M.Sc. (Agri.)*, N. M. College of Agriculture, N.A.U., Navsari, India. pp 57-75.

El Sohaimy, S. A.; Hamad, G. M.; Mohamed, S. E.; Amar, M. H. and Al-Hindi, R. R. (2015). Biochemical and functional properties of *Moringa oleifera* leaves and their potential as a functional food. *Glob. Adv. Res. J. Agric. Sci.*, **4** (4): 188-199.

Fuglie, L. J. (2000). New uses of *Moringa* studied in Nicaragua. *ECHO Development Notes*, **68**: 1-25.

Gunasekar, J.; Reddy, K. S.; Sindhu, G. P.; Anand, S.; Kalaiyarasi, G.; Anbarasu, M. and Dharmaraj, K. (2018). Effect of leaf extracts and panchagavya foliar spray on plant characters, yield and resultant seed quality of black gram (*Vigna mungo* L.) cv. CO 6. *Int. J. Curr. Microbiol. Appl. Sci.*, **7** (2): 3205-3214.

Irshad, S.; Matloob, A.; Iqbal, S.; Ibrar, D.; Hasnain, Z.; Khan, S; Rashid, N.; Nawaz, M.; Rao, M. I.; Wahid, M. A.; Al-Hashimi, A.; Elshikh, M. and Diao, Z. H. (2022). Foliar application of potassium and *Moringa* leaf extract improves growth, physiology and productivity of kabuli chickpea grown under varying sowing regimes. *Plos one*, **17** (2): 1-19.

Jackson, M. L. (1973). Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi. pp. 183-192.

Kaur, A. (2020). JIVAMRUTHAM: An effective activator of soil microorganisms. *Just Agriculturemultidisciplinary e-Newsletter*, **1** (1): 1-5.

Khatkar, R.; Abraham, T. and Joseph, S. A. (2007). Effect of biofertilizers and sulphur levels on growth and yield of black gram (*Vigna mungo* L.). *Legum. Res. Int. J.*, **30** (3): 233-234.

Kumawat, N.; Tomar, I. S.; Kumar, R. and Sahu, Y. K. (2017). Preparation of NADEP compost for sustaining farming community. *Popular Kheti*, **5** (4): 56-60.

Nivethadevi, P.; Swaminathan, C.; Kannan, P. and Tamilselvi, E. (2021). Seed fortification and foliar spraying with *Moringa oleifera* leaf extract enhances yield and yield attributes in black gram [*Vigna mungo* (L.) Hepper]. *Legum. Res. Int. J.*, 1-5.

Olsen, S. R.; Cole, C. W.; Wathade, F. S. and Dean, L. A. (1954). Estimation of available phosphorus in soil by extraction with $NaHCO_3$. USDA Cir. No.959, Washington, 13 p.

Piper, C. S. (1966). Soil and plant analysis, *Academic Press*, New York.

Prosecus, P. (2006). Biosynthesis-plant hormones and growth regulators: Chemistry and biology. Biosynth Ag. Co., Switzerland. Retrieved from http://www.biosynth.com/index. asp?topic_id.

Rathva, K. S. (2013). Response of pigeon pea (cv. Vaishali) to different planting geometries and organic sources. *Thesis M.Sc. (Agri.)*, N. M. College of Agriculture, N.A.U., Navsari, India.

Reddy, S. R. (2019). *"Principles of Agronomy"*, ANGR Agricultural University, S. V. Agricultural College, Tirupati, Andhra Pradesh, India. pp. 692-693.

Reddy, S. R. (2019). *"Principles of Agronomy"*, ANGR Agricultural University, S. V. Agricultural College, Tirupati, Andhra Pradesh, India. pp. 692-693.

Salunke, J. R. (2010). Feasibility of using banana pseudo-stem sap as liquid fertilizer in onion under drip irrigation. *Thesis Ph.D.*, Soil and Water Management Department, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India.

Selvakumar, G.; Reetha, S. and Thamizhiniyan, P. (2012). Response of biofertilizers on growth, yield attributes and associated protein profiling changes of black gram (*Vigna mungo* L. Hepper). *World appl. Sci. J.*, **16** (10): 1368-1374.

Senthil, A.; Ravi, R. and Vasanth, A. K. (2006). Quality characteristics of black gram papad. *Int. J. Food Sci. Nutri*., **57**: 29-37.

Senthil, A.; Ravi, R. and Vasanth, A. K. (2006). Quality characteristics of black gram papad. *Int. J. Food Sci. Nutri*., **57**: 29-37.

Subbiah, B. V. and Asija, G. L. (1956). A rapid procedure for the estimation of available nitrogen in soil. *Curr. Sci*., **25**: 259-260.

Zahran, H. H. (1999). *Rhizobium*-Legume symbiosis and nitrogen fixation under severe conditions and in an arid climate. *American Soc. Microbiol.*,**63** (4): 968-989.