Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 8 [7] June 2019 : 11-17

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.876
Universal Impact Factor 0.9804
NAAS Rating 4.95

ORIGINAL ARTICLE **OPEN ACCESS**

Yield, Nutrient Uptake and Available Nutrient of Soybean as Influenced by Organic and Inorganic Nutrient Management

Ambadas N. Mehetre[1], G. B. Suryawanshi[2], U.S. Surve[3] and V.V. Panchal [4]
Department of Agronomy, College of Agriculture, Kolhapur 416004 (India)
Email- ambadasmehetre@gmail.com

ABSTRACT
The field experiment was conducted during kharif 2014 at the Agronomy Farm, College of Agriculture, Kolhapur on sandy clay loam soil with the combined application of chemical fertilizers, FYM and biofertilizers in soybean and resulted revealed that the treatment 100 per cent GRDF recorded significantly highest soybean seed yield (29.22 q ha^{-1}) and straw yield (36.01 q ha^{-1}), higher total nutrient uptake (229.48, 29.83, 86.30 N, P_2O_5 and K_2O kg ha^{-1},respectively) and available nutrient (238.01, 20.77 and 277.50 N, P2O5 and K_2Okg ha^{-1} ,respectively) and it was followed by treatment 75 per cent RDF+ vermicompost 2.5 t ha^{-1} as compared to other treatment.
Key Word: *FYM, vermicompost, GRDF, biofertilizers, nutrient uptake.*

Received 09.01.2019 Revised 10.02.2019 Accepted 19.02. 2019

INTRODUCTION

Soybean *(Glycine max* L.*)* is known as Chinese pea and Manchurian bean which belongs to the family fabaceae, subfamily fabiodeae. Soybean is the major oil seed crop in the world, accounting for nearly 50 per cent of the total oil seeds acreage as well as production. It ranks third in vegetable oil economy in India, after groundnut and rapeseed.

Soybean has not only gained the vital importance in Indian agriculture, but also plays a decisive role in oil economy of India. Soybean seed contains 20 per cent oil and 40-42 per cent protein. The oil is used for frozen desserts, cookie, confections, ice-cream coating and coffee whiteners. Industrial uses of oil are in soap, paints, resins and drying oil. A number of protein-rich products, soy-milk, soy-paneer, soy-sauce and soy-flour can be produced from seeds. Soybean is preferred especially by vegetarians on account of its richness in protein, fat, carbohydrates, mineral, salts and vitamins (thiamine and riboflavin). Its sprouting grain contains considerable amount of vitamin C. Vitamin A is in the form of precursor of carotene. Soybean being the richest, cheapest and easiest source of best quality protein, fat and having a vast multiplicity of uses as food and industrial products called as a wonder crop [2].

In India, soybean is grown over an area of 93.03 lakh ha with a production of 101.28 lakh tonnes and with an average productivity of 1089 kg ha^{-1}. Madhya Pradesh, Utter Pradesh and Maharashtra are the major soybean producing states in India. In Maharashtra, it is grown over an area of 26.03 lakh ha with total production of 27.54 lakh tonnes with average productivity of 1058 kg ha^{-1}. [1].

The combined application of chemical fertilizers, FYM and biofertilizers in soybean resulted in higher yield and yield contributing characters *viz.,* number of pods plant^{-1}, seeds pod^{-1} and 100 seed weight. The quality of soybean was also improved with integrated nutrient management. [10].

There is scope for increasing the productivity of soybean by adapting the improved package of practices. Among these management practices, nutritional management is one of the important aspects. By considering this view, the experiment entitled, "Effect of organic and inorganic nutrients on growth and yield of soybean (*Glycine max* L.)" was planned the details regarding the material used and the methods followed during the course of the present investigation at Post Graduate Research Farm, Agronomy section, College of Agriculture, Kolhapur during *kharif*, 2014.

MATERIAL AND METHODS

An experiment entitled, "yield, nutrient uptake and available nutrient of soybean as influenced by organic and inorganic nutrient management" was conducted during *kharif,* 2014 at Post Graduate Research Farm, College of Agriculture, Kolhapur. The objectives of experiment were to study effect of organic and inorganic nutrients on yield, nutrient uptake and available nutrient of soybean and to find out suitable combination of organic and inorganic nutrient practice in soybean. The soil of the experimental field was sandy clay laom in texture, medium in available nitrogen (207.31 kg ha^{-1}), phosphorus (23.55 kg ha^{-1}) and fairly rich in available potassium (287.40 kg ha^{-1}) with pH 7.72. The experiment was laid out in a Randomized Block Design with seven treatments *viz.,* T_1- Absolute control, T_2 - 50 % RDF + FYM 5 t ha^{-1}, T_3 - 50 % RDF + vermicompost 2.5 t ha^{-1}, T_4 -75 % RDF + FYM 5 t ha^{-1}, T_5 -75 % RDF + vermicompost 2.5 t ha^{-1}, T_6 - FYM 5 t ha^{-1} + vermicompost 2.5 t ha^{-1} and T_7 -100 % GRDF. The varieties KS 103 (Kolhapur Soybean) were sown 30 cm x 10 cm spacing in second week of June. The seed rate under sole cropping was maintained at 75 kg ha^{-1}. A common seed treatment of *Rhizobium* + *PSB* is given @ 250 gm each10 kg^{-1} seed. Each experimental unit was replicated thrice with plot size of 5.4 x 3.6 m^2 and 5.0 x 3.0 m^2 as the gross and net plot, respectively.

Table 1.Physico-chemical properties of soil of the experimental plot

II)	**Chemical composition**			
a)	Available N (kg ha^{-1})	207.31	Alkaline potassium permanganate method	(Subbiah and Asija, 1956)
b)	Available P_2O_5 (kg ha^{-1})	23.55	Olsen's Method	(Olsen's Method, 1965)
c)	Available K_2O (kg ha^{-1})	287.40	Flame photometer method	(Jackson, 1973)
d)	Soil pH	7.72	Beckman pH meter	(Jackson, 1973)
e)	Electrical conductivity (dSm^{-1})	0.11	Conductometeric	(Jackson, 1973)
f)	Organic carbon (%)	0.9	Walkely and Black	(Jackson, 1973)

Uptake of nutrient by the crop:

On the basis of total dry matter of soybean and their N, P and K content, the N, P and K nutrients removed by crops were estimated by using following formula.

$$\text{Nutrient uptake (Kg ha}^{-1}\text{)} = \frac{\text{\% of nutrient concentration}}{100} \times \text{Total dry matter yield (kg ha}^{-1}\text{)}$$

RESULTS AND DISCUSSION

Mean seed yield (q ha^{-1}) and straw yield (q ha^{-1}) content in soybean seed as influenced by different treatments

Treatments	**Seed yield (q ha^{-1})**	**Straw yield (q ha^{-1})**
T_1) No fertilizers (Absolute control)	8.21	9.46
T_2) 50% RDF + FYM 5 t ha^{-1}	24.74	26.31
T_3) 50% RDF + V.C. 2.5 t ha^{-1}	25.89	30.20
T_4) 75% RDF + FYM 5 t ha^{-1}	26.42	33.61
T_5) 75% RDF + V.C. 2.5 t ha^{-1}	28.88	35.21
T_6) FYM 5 t ha^{-1} + V.C. 2.5 t ha^{-1}	24.52	26.73
T_7) 100% GRDF	29.22	36.01
'F' test	Sig.	Sig.
S.E. ±	1.08	0.93
C.D.at 5%	3.35	2.88
General mean	24.02	28.21

Seed Yield (q ha^{-1}):

Application of 100 % GRDF recorded significantly higher seed yield of soybean (29.22 q ha^{-1}) over rest of treatments and it was on par with 75 % RDF + vermicompost 2.5 t ha^{-1} (28.88 q ha^{-1}), 75 % RDF + FYM 5 t ha^{-1} (26.42 q ha^{-1}) and 50 % RDF + vermicompost 2.5 t ha^{-1} (25.89 q ha^{-1}).

However, treatment Absolute control (8.21q ha^{-1}) recorded significantly lowest mean seed yield of soybean as compared to other treatments under study. 50% RDF + FYM 5 t ha^{-1} (24.74 q ha^{-1}) and FYM 5 t ha^{-1} + vermicompost 2.5 t ha^{-1} (24.52 q ha^{-1}) which indicate role of integrated nutrient management in increasing seed yield of soybean. Higher seed yield was obtained with application of 100 % GRDF which might be due to significantly improvement in growth and yield attributes resulting into higher seed yield

of soybean. Similar results were reported by Bandyopadhy *et al.* [3], Waghmare *et al.* [12] and Devi *et al.* [5].

Straw Yield (q ha^{-1})

Application of 100 % GRDF recorded significantly higher straw yield of soybean (36.01 q ha^{-1}) over rest of treatments and it was on par with 75 % RDF + vermicompost 2.5 t ha^{-1} (35.21 q ha^{-1}) and 75 % RDF + FYM 5 t ha^{-1} (33.61 q ha^{-1}).

However, treatment Absolute control recorded significantly lowest mean straw yield (9.46 q ha^{-1}) of soybean as compared to other treatments. 50% RDF + FYM 5 t ha^{-1} (26.31 q ha^{-1}), 50% RDF + vermicompost 2.5 t ha^{-1} (30.20 q ha^{-1}) and FYM 5 t ha^{-1} + vermicompost 2.5 t ha^{-1} (26.73 q ha^{-1}) which indicates role of integrated nutrient management in increasing straw yield of soybean. Higher straw yield was obtained with application of 100 % GRDF which might be due to the higher production of dry matter in plants. Higher production of dry matter in plants might have improved values of yield attributes under organic and inorganic nutrient combinations treatment which resulted in higher straw yield of soybean. Similar results were reported by Singh and Rai [10] and Shinde *et al.* [9].

Yield

Significantly highest seed yield (29.22 q ha^{-1}) and straw yield (36.01 q ha^{-1}) was recorded in 100% GRDF and it was on par with 75% RDF + vermicompost 2.5 t ha^{-1}, 75% RDF + FYM 5 t ha^{-1}, 50% RDF + vermicompost 2.5 t ha^{-1} as compared to other treatments under study.

Nutrient studies:

Plant Studies:

Nitrogen content in plant:

Data presented in table revealed that nitrogen content in seed and straw was not significantly influenced due to different treatments. Mean nitrogen content in seed and straw was 7.03 and 0.46 %, respectively. Highest nitrogen content in seed and straw (7.09 and 0.62 %,) respectively was noticed in 100 % GRDF. Lowest nitrogen content in seed and straw was recorded in Absolute control (6.95 and 0.34 %,) respective.

Phosphorus content in plant:

Data presented in table revealed that phosphorus content in seed and straw was not influenced significantly due to different treatments. Mean phosphorus content in seed and straw was 0.45 and 0.27%, respectively. Highest phosphorus content in seed and straw (0.59 and 0.35 %,) respectively was noticed in 100 % GRDF. Lowest phosphorus content in seed and straw was recorded in Absolute control (0.33 and 0.19 %,) respectively.

Potassium content in plant

Data presented in table revealed that potassium content in seed and straw was not influenced significantly due to different treatments. Mean potassium content in seed and straw was 0.51 and 1.65 %, respectively. Highest potassium content in seed and straw (0.71 and 1.83 %,) respectively was noticed in 100 % GRDF. Lowest potassium content in seed and straw was recorded in Absolute control (0.31 and 1.52 %,) respectively.

Nutrient uptake by soybean crops:

Nitrogen uptake by plant (kg ha^{-1})

Data presented in table revealed that nitrogen uptake by plant was significantly influenced due to different treatments. Mean nitrogen uptake by plant was 182.53 kg ha^{-1}. Highest nitrogen uptake (229.48 kg ha^{-1}) was recorded significantly superior in 100 % GRDF than rest of treatments and it was on par with 75 % RDF + vermicompost 2.5 t ha^{-1} (224.95 kg ha^{-1}). Lowest nitrogen uptake by plant was recorded in Absolute control (60.26 kg ha^{-1}).

Phosphorus uptake by plant (kg ha^{-1})

Data presented in table revealed that phosphorus uptake by plant was significantly influenced due to different treatments. Mean phosphorus uptake by plant was 19.27 kg ha^{-1}. Highest phosphorus uptake (29.83 kg ha^{-1}) was recorded in 100% GRDF which was significantly superior over all other treatments. Lowest phosphorus uptake by plant was recorded in Absolute control (4.49 kg ha^{-1}).

Potassium uptake by plant (kg ha^{-1}):

Data presented in table revealed that potassium uptake by plant was significantly influenced due to different treatments. Mean potassium uptake by plant was 60.67 kg ha^{-1}. Significantly highest potassium uptake (86.30 kg ha^{-1}) was recorded in 100 % GRDF than rest of treatments and it was on par with 75 % RDF + vermicompost 2.5 t ha^{-1}(81.50 kg ha^{-1}). Lowest potassium uptake by plant was recorded in Absolute control (16.91 kg ha^{-1}). The total uptake of nutrients depends on yield of crop.

Soil Studies:

Available nitrogen (kg ha^{-1})

Data presented in table revealed that available nitrogen in soil was not significantly influenced due to different treatments. Mean available nitrogen in soil was 230.84 kg ha^{-1}. Highest available nitrogen in soil was (238.01 kg ha^{-1}) recorded in 100% GRDF. Lowest available nitrogen in soil was recorded in Absolute control (228.66 kg ha^{-1}).

Residual nitrogen increases with biological nitrogen fixation process and addition of root and leaf biomass of soybean crop in soil. These findings are conformity with Singh and Rai [10] and Rana and Badiyala [8].

Available phosphorus (kg ha$^{-1)}$:

Data presented in table revealed that available phosphorus in soil was not significantly influenced due to different treatments. Mean available phosphorus in soil was 19.67 kg ha^{-1}. Highest available phosphorus in soil was recorded in 100 % GRDF (20.77 kg ha^{-1}). Lowest available phosphorus in soil was recorded in Absolute control (17.91 kg ha^{-1}). These findings are conformity with Singh and Rai [10] and Chaturvedi and Chandel [4].

Available potassium (kg ha$^{-1)}$:

Data presented in table revealed that available potassium in soil was not significantly influenced due to different treatments. Mean available potassium in soil was 270.44 kg ha^{-1}. Highest available potassium (277.57 kg ha^{-1}) in soil was recorded in 100 %. Lowest available potassium in soil was recorded in Absolute control (263.91 kg ha^{-1}).

Application of organic material along with inorganic fertilizers enriched available potassium in soil. This might be due to fact all the available soil nutrients applied through organic fertilizers do not get available to crops in the year of application and only one third of nitrogen and phosphate may be effective while most of potash is available. These findings are conformity with Singh and Rai [10] and Chaturvedi and Chandel [14].

Table 3. Available nutrients content in the soil as affected by different treatments at harvest

Treatments	Available nutrients content (kg ha^{-1})		
	N	P_2O_5	K_2O
T_1) No fertilizers (Absolute control)	228.66	17.91	263.91
T_2) 50% RDF + FYM 5 t ha^{-1}	235.57	19.30	270.15
T_3) 50% RDF + V.C. 2.5 t ha^{-1}	235.90	20.28	271.47
T_4) 75% RDF + FYM 5 t ha^{-1}	236.21	20.49	271.55
T_5) 75% RDF + V.C. 2.5 t ha^{-1}	237.52	20.77	273.15
T_6) FYM 5 t ha^{-1} + V.C. 2.5 t ha^{-1}	235.01	18.17	265.39
T_7) 100% GRDF	238.01	20.77	277.50
'F' test	N.S	N.S	N.S
S.E. ±	0.47	0.57	2.56
C.D.at 5%	--	--	--
General mean	230.84	19.67	270.44

Table 4. Nutrient uptake in soybean seed and straw as affected by different treatments at harvest

Treatments	Nitrogen (kg ha^{-1})			Phosphorus (kg ha^{-1})			Potassium (kg ha^{-1})		
	Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total
T_1) No fertilizers (Absolute control)	57.05	3.21	60.26	2.70	1.29	4.49	2.54	14.37	16.91
T_2) 50% RDF + FYM 5 t ha^{-1}	173.42	10.52	183.94	10.14	6.57	16.71	10.63	41.30	51.93
T_3) 50% RDF + V.C. 2.5 t ha^{-1}	182.00	12.68	194.68	11.65	8.15	19.80	12.94	49.83	62.77
T_4) 75% RDF + FYM 5 t ha^{-1}	186.26	17.14	203.4	12.68	10.08	22.76	15.58	58.41	73.99
T_5) 75% RDF + V.C. 2.5 t ha^{-1}	204.18	20.77	224.95	14.72	11.61	26.33	18.48	63.02	81.50
T_6) FYM 5 t ha^{-1} + V.C. 2.5 t ha^{-1}	171.14	9.89	181.03	9.07	5.88	14.95	9.07	39.82	48.89
T_7) 100% GRDF	207.16	22.32	229.48	17.23	12.60	29.83	20.74	65.89	86.63
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
S.E. ±	6.76	0.75	6.54	0.51	0.43	1.09	0.58	2.26	2.65
C.D.at 5%	20.84	2.32	17.20	1.59	1.34	3.36	1.79	6.98	8.18
General mean	168.74	13.79	182.53	11.17	8.09	19.27	12.85	47.52	60.67

Table 5. Nutrient (NPK) content in seed and straw of soybean as influenced by different treatments

Treatments	Nitrogen (%)		Phosphorus (%)		Potassium (%)	
	Seed	Straw	Seed	Straw	Seed	Straw
T_1) No fertilizers (Absolute control)	6.95	0.34	0.33	0.19	0.31	1.52
T_2) 50% RDF + FYM 5 t ha^{-1}	7.01	0.40	0.41	0.25	0.43	1.57
T_3) 50% RDF + V.C. 2.5 t ha^{-1}	7.03	0.42	0.45	0.27	0.50	1.65
T_4) 75% RDF + FYM 5 t ha^{-1}	7.05	0.51	0.48	0.30	0.59	1.73
T_5) 75% RDF + V.C. 2.5 t ha^{-1}	7.07	0.59	0.51	0.33	0.64	1.79
T_6) FYM 5 t ha^{-1} + V.C. 2.5 t ha^{-1}	6.98	0.37	0.37	0.22	0.37	1.49
T_7) 100% GRDF	7.07	0.62	0.59	0.35	0.71	1.83
'F' test	N.S	N.S	N.S	N.S	N.S	N.S
S.E. ±	0.21	0.02	0.02	0.01	0.02	0.07
C.D.at 5%	--	--	--	--	--	--
General mean	7.03	0.46	0.45	0.27	0.51	1.65

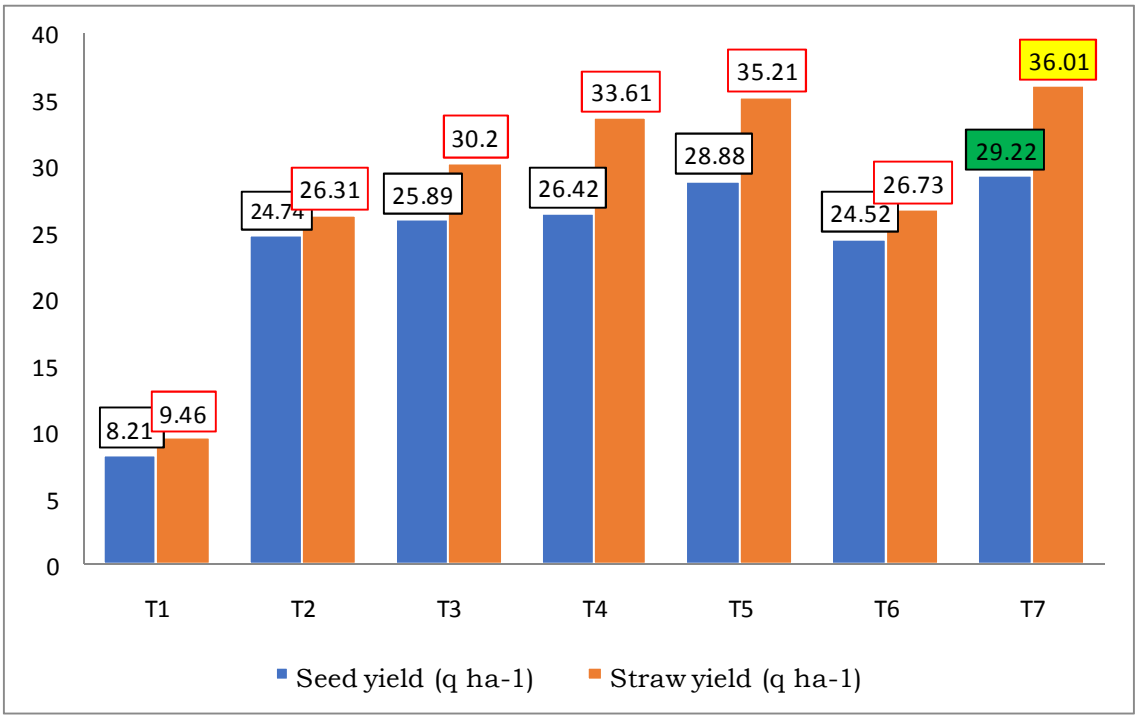

Fig 1.Seed yield (q ha^{-1}) and straw yield (q ha^{-1}) of soybean as influenced by different treatments

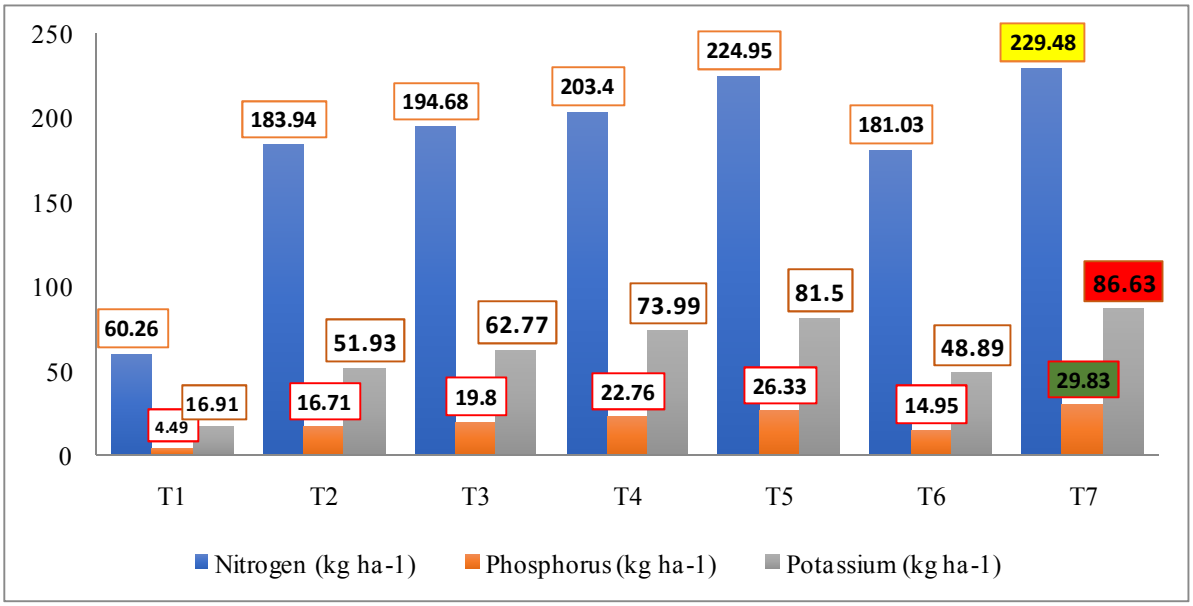

Fig 2.Nutrient uptake in soybean seed and straw (kg ha^{-1}) as affected by different treatments at harvest

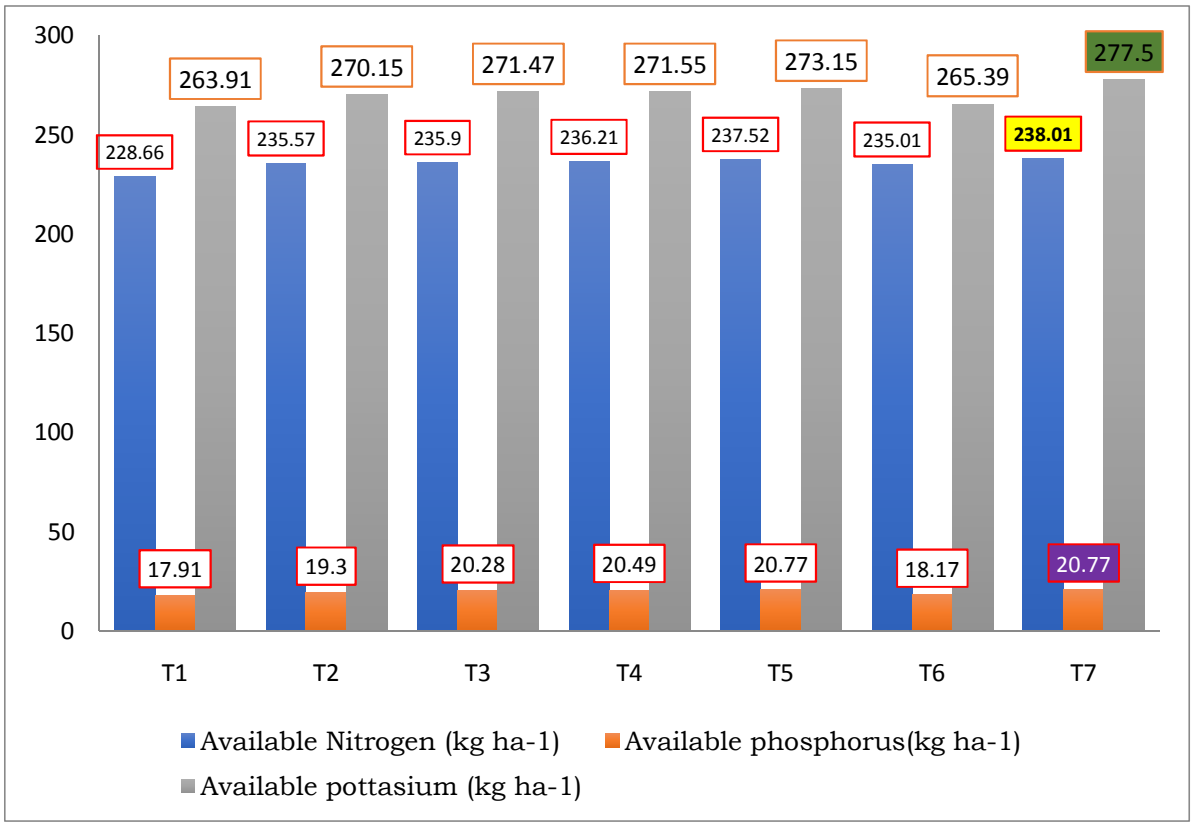

Fig 3.Available nutrients content (kg ha^{-1}) in the soil as affected by different treatments at harvest

CONCLUSION

On the basis of one season experimentation, following broad conclusions can be drawn.

1. Application of 100% GRDF was found superior in recording yield contributing characters, yield and nutrient studies of soybean.
2. Among the organic and inorganic nutrient combinations, an application of 75% RDF + vermicompost 2.5 t ha^{-1} was found superior in recording yield contributing characters, yield and nutrient studies of soybean.

As these findings are based on one season data, it needs one or more season or year experimentation for confirmation.

ACKWOLEDGEMENT
Author very thankful to Department of Agronomy, College of Agriculture, Kolhapur 416004 (India) provide all the necessary facility for research works.

REFERENCES

1. Anonymous, (2011).Directorate of Economics and Statistics. Govt. of India.
2. Balasubramaniyan, P. and Palaniappan, S.P. (2012).Principles and practices of Agronomy.
3. Bandyopadhyay, K. K., Ghosh, P. K., Chaudhary, R. S., Mhati K. G., Mandal K.G. and Misra A. K., (2004). Effect of integrated nutrient management practices in soybean (*Glycine max* L.) and sorghum (*Sorghum bicolor*) in sole and intercropping system in a vertisol. *Indian J. Agric. Sci.* **74** (2): 55-63.
4. Chaturvedi, S. and Chandel A. S., (2005). Influence of organic and inorganic fertilization on soil fertility and productivity of soybean (*Glycine max* L.*). Indian J. Agron.* **50** (4): 311-313.
5. Devi, K. N., Singh, T. B., Singh, A. H., Singh, B. N. and Diana, S., (2013). Influence of inorganic, biological and organic manures on nodulation and yield of soybean (*Glycine max* L.) and soil properties. *AJCS* **7** (9):1407-1415.
6. Jackson, M. L., 1973. Soil chemical analysis, Prentice hall of India Pvt. Ltd., New Delhi.
7. Olsen, S. R., Cole, C. W., Wathdable, F. S. and Dean, L. A. (1965). Estimation of available phosphorus in soil by extraction with CO_3.*USDA Circ*., 939.
8. Rana, R and Badiyala, D., (2014). Effect of integrated nutrient management on seed yield, quality and nutrient uptake of soybean (Glycine max L.) under mid hill conditions of Himachal Pradesh. *Indian J. Agron.* **59** (1): 641-645.
9. Shinde, P. S., Sankpal, V. Y. and Jawale, S. M., (2009). Effect of integrated nutrient management on yield attributes and quality of soybean (*Glycine max* L.).*J. Maharashtra Agric. Univ.* 34 (1):107-108.
10. Singh, R. and Rai, R. K., (2004). Yield attributes, yield and quality of soybean (*Glycine max* L.) as influenced by integrated nutrient management. *Indian J. Agron.* **49** (4): 271-274.
11. Subhaiah, B. V. and Asija, G. L., (1956). A rapid procedure for the estimation of available nitrogen in soil. *Curr. Sci*. **25** (8): 259-266.
12. Waghmare, Y. M., Gokhale, D. N. and Pawar, H. D., (2012). Effect of integrated nutrient management on yield, yield attributes and quality of soybean (*Glycine max* L.). *J. Agric. Res. Technol.* **37** (3): 370-372.13

CITATION OF THIS ARTICLE
Ambadas N. Mehetre, G. B. Suryawanshi, U.S. Surve And V.V. Panchal. Yield, Nutrient Uptake And Available Nutrient Of Soybean As Influenced By Organic And Inorganic Nutrient Management Bull. Env. Pharmacol. Life Sci., Vol 8 [7] June 2019: 11-17