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Original Research Article

Nutrient Management Practices for Enhancing Soybean Production in Rainfed condition

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Soybean Production, Nutrient Management

A B S T R A C T

An experiment was conducted in Kharif, at AICRPDA in College of Agriculture Indore, during 2017-18, to study the effects of different Nutrient Management Practices for enhancing Soybean Production. Here 3 replications and 9 treatments were taken in RBD. Highest yield (908 kg ha^{-1})recorded from Treatment 6(FYM 6t ha^{-1} + N20 P13) followed by T7 and T9. Lowest yield was recorded from control. Similarly, best yield attributing characters - Plant height (51.98), number of branches $plant^{-1}$ (4.13 $plant^{-1}$), number of pods $plant^{-1}$ (42.07 $plant^{-1}$), plant population (19.33 $plot^{-1}$), were recorded from treatment 6 (FYM 6t ha^{-1} + N20 P13). In all the different treatments, T6 was found superier and control was found inferior. Result shows that treatments in combination of inorganic and organics were superior over control.

Introduction

Soybean is one of the most important legume crop in the world. Soybean is grown approximately 6% of world's arable land. The latest survey by the apex industry body, the Soybean Processors' Association (SOPA), estimates India's soybean output at 8.35 million tonnes for the harvesting season 2017-18.After an extensive survey in the major soybean growing districts in Madhya Pradesh, Maharashtra and Rajasthan.

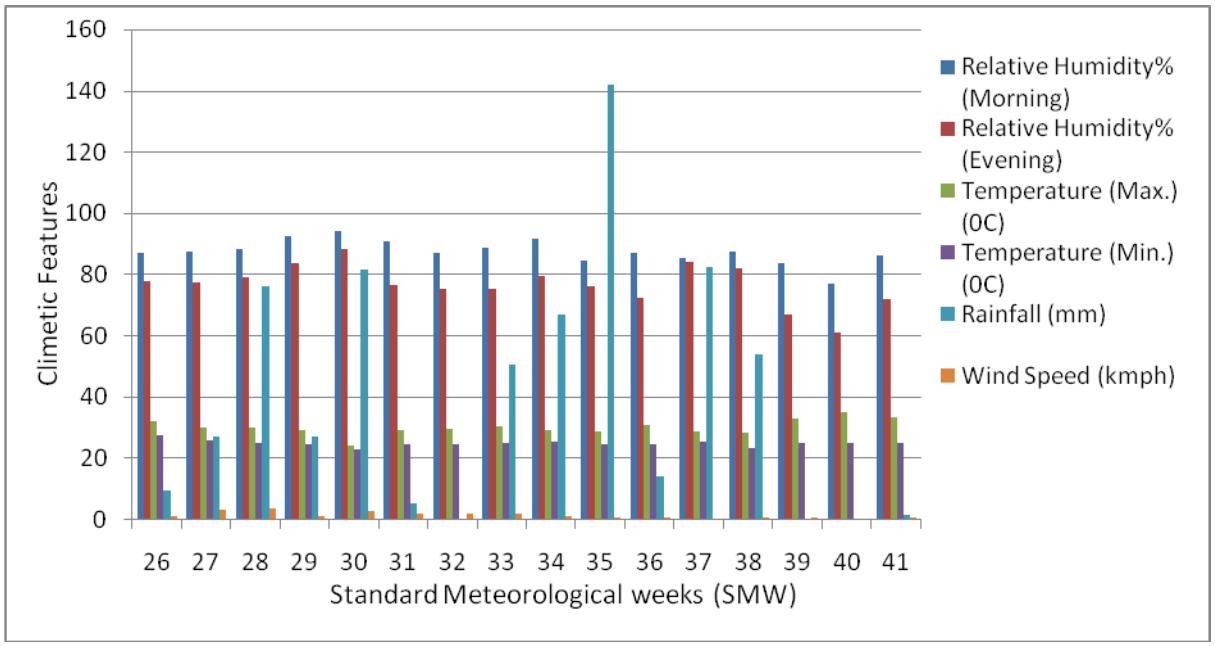
Traditional non-fermented food uses of soybeans include soy milk from which tofu and tofu skin are made. Fermented soy foods include soy souce, fermented bean paste, natto and tempeh. Together protein and soybean oil content account for 56% of dry soybeans by weight (36% protein and 5% ash). The remainder consists of 30% carbohydrates, 9% cotyledons and 2% hypocotyl axis or germ. 100 grams of raw soybeans supply 446 calories and 9% water, 30% carbohydrates, 20% total fat and 36% protein.

Soybean sown with the onset of the monsoon, is a kharif crop that contributes to nearly a third of India's overall oilseeds' output and sets the trend for other seeds such as groundnut and sesame in the summer sowing season, and rapeseed and mustard in winter. Cultivation is successful in climates with hot summers, with optimum growing conditions in mean temperatures of 20^{o} to 30° C (68^{o} to 86°F), temperatures of below 20 °C and over 40 °C (68 °F, 104°F) stunt growth significantly. They can grow in a wide range of soils, with optimum growth in moist alluvial soils with a good organic content.

Like most legumes, soybean is able to obtain its own Nitrogen (N) through the process of Nitrogen fixation. Nitrogen fixation is achieved through the biological relation between soybean and particular species of soil bacteria, *Brady Rhizobium japonicum.* The bacteria obtains sugar from soybean as their N source and soybean obtain N from them. Thus it helps in reducing the cost of production in soybean by reducing the use of N fertilizer. For best results, though, an inoculum of the correct strain of bacteria should be mixed with the soybean (or any legume) seed before planting. Modern crop cultivars generally reach a height of around 1 m (3.3 ft.) and take 80-120 days from sowing to harvesting.

Materials and Methods

A long term studies on the impact of organic, integrated and chemical nutrient management practices on soybean productionat AICRPDA, Indore, during 2017-18. From sowing to harvesting 16Standard Meteorological weeks were recorded. 34.7^0 C was the heighest maximum temperature, 27.36^0 C was highest minimum temperature, 636.50 mm were the total rainfall recorded during the SMW.



Treatment details:

Sym	Treatment	Treatment detail
T1	N0P0	Control
T2	N20P13	Fertilizer N and P @ 20 and 13 $kgha^{-1}$
T3	N30P20	Fertilizer N and P@ 30 and 20 $kgha^{-1}$
T4	N40P26	Fertilizer N and P@ 40 and 26 $kgha^{-1}$
T5	N60P35	Fertilizer N and P @ 60 and 35 $kgha^{-1}$
T6	FYM 6t ha^{-1} + N20P13	FYM @ 6 t ha^{-1} in rainy season only plus fertilizer N and P @ 20 and 13 $kgha^{-1}$, respectively to each crop.
T7	Crop residues 5t ha^{-1}+ N20P13	Crop residues of soybean @ 5t ha^{-1}
T8	FYM 6t ha^{-1}	FYM @ 6 t ha^{-1}
T9	Crop residues 5t ha^{-1}	Residues are applied to each crop after emergence of crop in between crop rows as surface mulch.

Other experimental details:

1. Crop: soybean (var. JS-335)
2. Design: RBD
3. Number of treatments: 9
4. Number of replications: 3
5. Plot size: Gross: 10m X 07.20m, Net: 09m X 06.40m
6. Total number of plots: 27
7. Seed rate: 80 kg ha
8. Date of sowing: 28/06/2017
9. Date of harvesting: 9/10/2017

Results and Discussion

Different nutrient management practices had significant effect on soybean yield and yield attributing characters.

Height

The application of T6 (FYM 6t ha^{-1}+ N20 P13)recorded the significantly highest plant height over control.The highest plant height was recorded in T6 (51.98 cm), followed by T7 (47.70 cm) andT9 (47.18 cm).Treatments involving FYM and crop residues integrated with inorganics were observed superior as compared to others.

Branches

Significantly higher number of branches are observed in T6 (FYM 6t ha^{-1}+ N20 P13) over control. The highest number of branches was recorded in T6 (4.13), followed by T7 (3.93) and T9 (3.83). Treatments involving FYM and crop residues integrated with inorganics were observed to be superior as compared to others.

Pods

The highest number of pods was recorded in T6 (42.07), followed by T7 (33.17) and T9 (30.77). Treatments involving FYM and crop residues integrated with inorganics were observed to be superior as compared to others. Number of grains per pod was found 3. Highest number of grains per plant were found in treatment T6 (FYM 6 t ha^{-1}+ N20 P13)and lowest in case of control.

Nodules

Significantly higher number of root nodules are observed in T6 (FYM 6t ha-1+ N20 P13) over control. The highest number of nodules were recorded in T6 (41), followed by T7 (36) and T9 (35.67). Treatments involving FYM and crop residues integrated with inorganics were observed to be superior as compared to others.

Plant population

Significantly higher plant population are observed in T6 (FYM 6t ha^{-1}+ N20 P13)over control. The highest plant population was recorded in T6 (19.33 plants $plot^{-1}$), followed by T7 (19 plants $plot^{-1}$) and T9 (18.67 plants $plot^{-1}$). Treatments involving FYM and crop residues integrated with inorganics were observed to be superior as compared to others.

Effect of different treatments of Nutrient Management on TDM (g), seed yield $plant^{-1}$, test weight (g), seed and straw yield (kg ha^{-1})

Seed yield (kg ha^{-1})

The data on the effects of nutrient management on yield of soybean as influenced by different treatments have been presented in (Table 2).Treatments involving FYM and crop residues were observed to be superior as compared with recommended dose of fertilizer alone. The highest seed yield of (908 kg ha^{-1}) was recorded due to treatment T6 (FYM 6 t ha^{-1}+ N20 P13) over control, followed by T7 (805kg ha^{-1}) and T9 (772kg ha^{-1}).

TDM Plant^{-1}(g)

The data on the effect of nutrient management on yield of soybean as influenced by different treatments have been presented in (Table 2). The highest TDM of (13.84 g) was recorded due to treatment T6 (FYM 6 t ha^{-1}+ N20 P13)than control.

Straw yield (kg ha^{-1})

The data on the effect of nutrient management on yield of soybean as influenced by different treatments have been presented in (Table 2). The highest straw yield of (1811 kg ha^{-1}) was recorded due to treatment T6 (FYM 6 t ha^{-1}+ N20 P13)) than control.

Test weight(g)

The data on the effect of nutrient management on yield of soybean as influenced by different treatments have been presented in (Table2). The highest test weight of (14.43 g) was recorded due to treatment T6 (FYM 6 t ha^{-1}+ N20 P13)) than control.

Seed yield plant^{-1}(g)

The data on the effect of nutrient management on seed yield of soybean as influenced by different treatments have been presented in (Table2). The highest seed yield of (5.23 g plant^{-1}) was recorded due to treatment T6 (FYM 6 t ha^{-1}+ N20 P13) than control.

Table.1 Effect of different treatments of Nutrient Management on Plant height (cm), Number of branches plant-1, Number of Pods plant-1 at harvest andNumber of Nodules count at 40 DASof soybean

Sym.	Treatments	Height (cm)	No. of branches plant $^{-1}$	No. of pods plant $^{-1}$	No. of nodules count plant $^{-1}$	Plant population plot^{-1}
T1	Control	40.04	2.60	19.33	22.33	14.67
T2	N20 P13	42.63	2.93	26.37	23.67	15.33
T3	N30 P20	44.47	3.47	27.63	34.33	17.33
T4	N40 P26	45.38	3.60	28.13	35.00	18.33
T5	N60 P35	45.20	3.60	27.77	34.67	17.67
T6	FYM 6 t ha^{-1} + T2	51.98	4.13	42.07	41.00	19.33
T7	Residues 5 t ha^{-1} + T2	47.70	3.93	33.17	36.00	19.00
T8	FYM 6 t ha^{-1}	43.19	3.07	26.73	28.67	16.00
T9	Residues 5 t ha^{-1}	47.18	3.83	30.77	35.67	18.67
	SE(m) ±	2.39	0.34	1.93	1.86	1.26
	CD at 5%	6.80	0.95	5.50	5.24	3.58

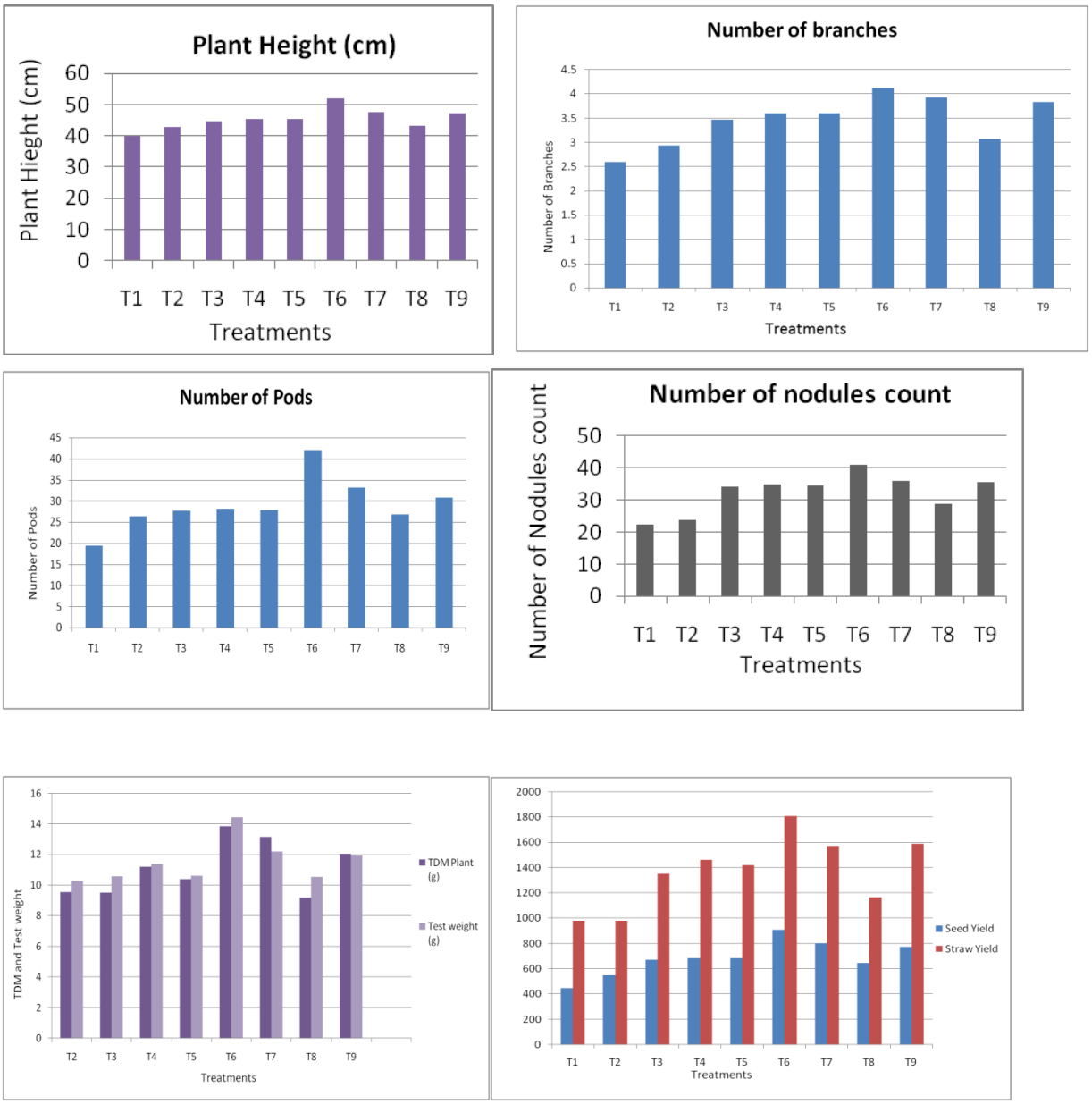


Fig.1 Effect of different nutrient management Practices on yield and yield attributing characters of soybean

Table.2 Effect of different treatments of Nutrient Management on TDM (g), seed yield plant^{-1}, Test weight (g), seed and straw yield (kg ha^{-1})

Sym	Treatments	TDM Plant^{-1} (g)	Test weight (g)	Seed yield plant^{-1} (g)	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T1	Control	6.12	9.30	2.59	450	979
T2	N20 P13	9.55	10.27	3.16	549	982
T3	N30 P20	9.49	10.57	3.88	674	1355
T4	N40 P26	11.18	11.37	3.95	685	1464
T5	N60 P35	10.37	10.60	3.93	683	1421
T6	FYM 6 t ha^{-1} + T2	13.84	14.43	5.23	908	1811
T7	Residues 5 t ha^{-1} + T2	13.14	12.20	4.64	805	1574
T8	FYM 6 t ha^{-1}	9.19	10.53	3.72	645	1169
T9	Residues 5 t ha^{-1}	12.04	11.93	4.45	772	1590
	SE(m) ±	**0.66**	**0.61**	**0.34**	**62**	**172**
	CD at 5%	**1.85**	**1.74**	**0.95**	**177**	**490**

Result shows that treatments in combination of inorganic and organics were superior over control. Highest yield recorded from Treatment 6 (FYM 6t ha^{-1}+ N20 P13) followed by T7 and T9. Lowest yield was recorded from control. Similarly, best yield attributing characters were recorded from treatment 6. In all the different treatments, T6 was found superior which is combination of organics and inorganics and control was found inferior.

Gajbhiye *et al.* (2011) studied that the highest grain yields of soybean (27.7 q ha^{-1}) and wheat (31.3 q ha^{-1}) were obtained by 75% N through RDF + 25% of N through FYM @ 5 t ha^{-1} and sustainable yield index (SYI) varied from 0.28 to 0.79 in soybean and 0.26 to 0.84 in wheat crop.

Mukherjee (2012) concluded an experiment and reported that all the growth and yield attributing character was maximum with 75 % recommended dose of fertilizer + 25 % N applied through FYM + PSB + Rhizobium. The highest seed yield plant^{-1} was recorded in treatment 75 % recommended dose of fertilizer + 25 %N applied through FYM + PSB + Rhizobium culture (23.31 g) which was on par with 50 % recommended dose of fertilizer + 50 % N through FYM + PSB + Rhizobium culture.

Koushal and Singh (2011) studied the impact of integrated nutrient management in soybean on residual fertility status of soil. The highest number of pods per plant (80.40) and highest test weight (17.02 g) was recorded in the treatment where 50 % recommended N applied through urea + 50 % N through FYM + PSB and the lowest of these were found in the control treatment.

Konthoujam *et al.* (2013) revealed that integration of 75% RDF with vermicompost at the rate 1 tha^{-1} and PSB produced significantly higher plant height, number of nodules plant^{-1}, dry weight of nodules plant^{-1}, pods plant^{-1} and seed index than the other treatments. Similarly, significantly higher grain and stover yield were obtained from the application of 75% RDF as inorganic fertilizer in combination with vermicompost at the rate of 1 tha^{-1} followed by seed

inoculation of PSB. The available N, P and K of soil after the harvest of soybean were improved significantly due to the integration of inorganic fertilizers with organic manures.

Khursheed *et al.* (2013) observed that the application of poultry manure and vermicompost along with chemical fertilizers for supply of nitrogen, phosphorus and potassium resulted in higher grain yield of rice.

Billore *et al.* (2014) evaluated that application of FYM @ 10 t ha^{-1} increased the seed yield by 10.9, 21.2, 23.3 and 38.2 %, respectively in North Plain, North Eastern, Central and Southern zones, while corresponding mean increase in yield due to inorganic fertilizers was 11.7, 52.9, 47.3 and 40.6%, respectively. Integration of inorganic fertilizers with FYM further increased the seed yield over control by 10.9, 7.5, 5.5 and 9.8 % in North Plain, North Eastern, Central and Southern zones, respectively.

Kanton *et al.* (2016) found that organic and inorganic fertilizer effects on the growth and yield of maize, which revealed that the inorganic fertilizers with micro-nutrients, such as S, Zn, and Mg, (i.e., Actyva and 21:10:10:2 S) produced taller plants, caused earlier tasseling and silking and produced higher grain yields on account of increased straw yields, plant height, stem girth, grain size and harvest indices than organic fertilizers. Poultry manure and sheep manure were the best among the organic sources evaluated.

Singh *et al.* (2017) conducted an experiment and found highest soybean seed yield (2122 kg ha^{-1}) was recorded due to application of 6 t ha^{-1}FYM. The highest gross and net returns were also obtained due to the same treatment 6 t FYM ha^{-1} lowest in case of control. Highest plant height (55.41 cm) was recorded by application of N20 P13 5 t ha^{-1} residues. Highest number of branch $plant^{-1}$ (4.40), pods $plant^{-1}$ (47.07) and TDM $plant^{-1}$ (39.78 g) obtained by N60 P35. Highest MWD (1.91 m) was recorded by N20 P13 + 6 t FYM ha^{-1} and highest porosity (56.99%) from the same treatment.

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