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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON YIELD AND ECONOMICS OF MUSTARD

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ABSTRACT
Field experiments were conducted during rabi season of 2010-11 and 2011-12 at K.A.P.G. college research farm, Allahabad UP, to study the effect of integrated nutrient management on yield and economics of mustard. Experiments were conducted in RBD and data revealed that the addition of compost + PSB to all the three levels of P and S ($P_{40}S_{30}$, $P_{60}S_{45}$ and $P_{80}S_{60}$) caused significant increase in seed yield over P and S levels alone during both the years. The yield varied from 1210.95 to 2610.50 kg ha^{-1} and 1190.20 to 2656.23 kg ha^{-1} during first and second year respectively and maximum yield was recorded with $P_{80}S_{60}$+ Compost +PSB. IPNM treatments increase the mustard yield and application of $P_{80}S_{60}$+Compost+PSB increases yield 119.37% over control and 85.17% over simulated farmers' practice. It is found that, application of compost and PSB to P and S combinations gave the highest number of siliqua plant^{-1} during both the years. It is reported that maximum number of seeds siliqua^{-1} was found in $P_{80}S_{60}$+ PSB and $P_{80}S_{60}$+ Compost +PSB during first and second year respectively. Correlation studies showed that both number of siliqua plant^{-1} and number of seeds siliqua^{-1} had highly significant and positive correlation with yield. Significant increase in oil content was observed during both the years and maximum increase was obtained in $P_{80}S_{60}$ + compost + PSB which was 3.55% and 5.5% higher over control during the first and second year respectively. Economic analysis of IPNM treatments revealed that, highest B: C ratio (3.34) and VCR (2.34) were found in $P_{80}S_{60}$+ Compost + PSB treatment.

KEY WORDS: Compost, correlation, PSB, phosphorous, sulphur, siliqua, levels.

INTRODUCTION
Fertilizers play vital role in production and productivity of any crop but continuous and imbalanced use of high analysis chemical fertilizers badly influences production potential and soil health. Subsequently most of the productive soils become unproductive. Use of chemical fertilizers in combination with organic manure is essentially required to improve the soil health (Prasad *et al*., 2010). Chemical fertilizers/organic manures alone cannot sustain the desired levels of crop production under continuous farming. Integrated nutrient management is very essential which not only sustains high crop production over the years but also improves soil health and ensures safer environment (Verma *et al.,* 2010). Integration of chemical and organic sources and their efficient management have shown promising results not only in sustaining the productivity but also maintaining the soil health (Vijaya Sankar Babu *et al.,* 2007). Integrating organic manure (FYM @ 10-15 ton/ha) with 100% recommended NPK fertilizer doses not only sustain high productivity but also maintain fertility in most of the intensive cropping systems and soil types. The results further revealed that soil type is one of the most important factor affecting fertilizer use efficiency and crop yields. Therefore, sustained efforts are needed to maintain and improve this most important natural resource base –the soil through judicious integration of mineral fertilizers, organic and green manures, crop residues and bio-fertilizers so that it nourishes intensive cropping without being irreversibly damage in the process. Adoption of integrated plant nutrient supply and management strategies for enhancing soil quality, input use efficiency and crop productivity is extremely important for food and nutritional security in Indian agriculture (Swarup, 2010). The basic concept underlying IPNS is the maintenance or adjustment of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of the plant nutrient in integrated manners. Fertilizers play vital role in production and productivity of any crop but continuous and imbalanced use of high analysis chemical fertilizers like Urea, DAP, NPK etc. badly influences production potential and soil health. Subsequently, most of the productive soils become unproductive. Use of chemical fertilizer in combination with organic manure and bio fertilizers is essentially required to improve the soil health. Increase in fertilizer use efficiency must be ensured to achieve sustainable production. Chemical fertilizers or organic manures or bio-fertilizers alone cannot sustain the desired levels of soil fertility and crop production under continuous farming practices. Integrated plant nutrient system (IPNS) is a way, which not only sustains high crop production over the years but also improves soil health and ensures safer environment. The IPNS helps to restore and sustain soil fertility and crop productivity. It also helps to check the emerging deficiency of nutrient other than NPK favourably, effects the physical, chemical and biological

environment of soils and brings economy and use efficiency in fertilizers. In the intensive agriculture, importance of integrated management of nutrient resources is being magnified to inorganic overall soil health (Prasad *et al*., 2002). The farmyard manure (FYM) itself contains reasonable amounts of nutrients which become available to plants upon decomposition besides enhancing availability of native as well as applied nutrients (Chander *et al.,* 2010). The phosphate solubilizing microorganisms (Pseudomonas) play an important role in conversion of unavailable inorganic P (Ca-P, Fe-P and Al-P) into available inorganic P forms through secretion of organic acids and enzymes (Singh *et al.,* 2011). Sulphur, now recognized as forth major nutrient with nitrogen, phosphorus and potassium, is a constituent of three sulphur containing amino acids (cysteine, cystine and methionine), which are the building blocks of protein and about 90% of plant S is present in these amino acids. Sulphur improves protein and oil content in seeds and is also associated with special metabolism in plant and the structural characteristics of protoplasm. Adequate supply of sulphur has been reported to enhance photosynthetic efficiency and productivity of *Brassica* genotypes (Ahmed & Abdin, 2000). Sulphur has profound effect on increasing the oil content in seeds by 2-3% in sesame and safflower, 3-4% in sunflower, 4-5% in linseed, 4-7% in soybean and 5-9% in rapeseed and mustard and thereby enhances the oil yield. Crops need sulphur generally as much of phosphorus and one tenth of nitrogen, while some crops like raya, mustard, gobhisarson, soybean, pluses need more. Concentration of sulphur in seeds is found to be the highest (1.1-1.7%) in oilseeds, intermediate (0.24-0.32%) in pluses and the lowest (0.12 – 0.20%) in cereal crops. Average removal of sulphur by one tone of oilseeds ranges between 8-12 kg, by pulses 4-8 kg as compared to 3-5 kg sulphur by cereal crops. Similarly, oilseeds from one ha remove sulphur between 10-25 kg and that of pulses 5-10 kg annually which depends upon nature of crop, soil and environmental factors (Singh, 1999).

Keeping in view the central role of integrated nutrient management in improving crop yield and produce quality of mustard, the present investigation has been conducted.

MATERIALS & METHODS

Field experiments were conducted during 2010 to 2012 in rabi season at the research farm of K.A.P.G. college Allahabad (UP). Geographically Allahabad district is situated in sub- tropical and semi arid zone of India and it lies between latitude of 24º 47ʹ to 25º 47ʹ north and longitude of 81º 9ʹto 82º 21ʹ east. The average temperature ranges from 12-22ºC in winter and 33-45ºC in summer with mean R.H. is about 65 per cent. The initial characteristics of experimental soils (0-15 cm depth) were; texture – sandy loam, P^H 8.6, EC 0.29 dSm^{-1}, organic carbon 0.49%, alkaline $KMnO_4$ N 156.8 kg ha^{-1}, Olsen's P 8.5 kg ha^{-1}, ammonium acetate extractable K 168.0 kg ha^{-1} ,$Cacl_2$ extractable S 5.8 kg $ha^{-1}$and DTPA extractable Zn, Fe, Mn& Cu were 3.06, 4.17, 6.55 and 0.24 ppm respectively. Experiments were laid out in RBD with 14 treatments namely T_1- Control, T_2- $P_{40}S_{30}$, T_3- $P_{40}S_{30}$ + Compost, T_4- $P_{40}S_{30}$ + PSB ,T_5- $P_{40}S_{30}$ + Compost + PSB, T_6- $P_{60}S_{45}$, T_7- $P_{60}S_{45}$+ Compost, T_8- $P_{60}S_{45}$+ PSB, T_9- $P_{60}S_{45}$+ Compost + PSB, T_{10}- $P_{80}S_{60}$, T_{11}- $P_{80}S_{60}$+ Compost, T_{12} $P_{80}S_{60}$+ PSB, T_{13}- $P_{80}S_{60}$+ Compost + PSB and T_{14}- Farmers' Practices ($N_{30}P_{50}$) and 3 replications. Three levels of phosphorus *i.e.* 40, 60 & 80 kg ha^{-1} and three levels of sulphur i.e. 30, 45 & 60 kg ha^{-1} were chosen with or without compost and PSB. Entire dose of phosphorus and sulphur were applied as basal dressing at the time of sowing. Phosphorus and sulphur were applied through di-ammonium phosphate (DAP) and gypsum respectively. Compost was applied @ 10 tones ha^{-1} through rural FYM. Compost (0.58% N, 0.24%P and 0.67% K) was supplied in the field before 30 days of sowing of test crop at field capacity.Nitrogen and potash were applied @ 120 kg and 50 kg ha^{-1} through urea and muriate of potash (MOP) respectively. Half of nitrogen and full quantity of potash were applied as basal dressing in each plot at the time of sowing. Remaining half of nitrogen was applied in two equal split doses after first and second irrigation. Soil and plant analysis were done with the help of standard methods. Mustard variety Pusa Jai Kisan was sown in both year for the study. Five plants were selected randomly from each plot for sampling purposes and observations were recorded. Statistical tools applied as and when required for the study. Economics of experiment was worked out, net return is the product of gross cost subtracted from gross return while, B: C ratio was obtained when gross return divided by gross cost. VCR is an expression of net return divided by gross cost showed that the economic benefit excluding the cost of experimentation.

RESULTS & DISCUSSION

Seed yield

Among the P and S levels there were significant differences at each levels indicating that each increment in P and S levels resulted in large increases in seed yield (Table-1). During first year addition of compost to $P_{40}S_{30}$and $P_{80}S_{60}$did not caused a significant increase but addition of compost to $P_{60}S_{45}$resulted in a significant increase in the seed yield. Addition of PSB to $P_{60}S_{45}$ was significantly higher than $P_{60}S_{45}$, but PSB added with $P_{40}S_{30}$ and $P_{80}S_{60}$ were not significantly superior to $P_{40}S_{30}$ and $P_{80}S_{60}$ alone. Addition of compost + PSB to all the three levels of P and S ($P_{40}S_{30}$, $P_{60}S_{45}$ and $P_{80}S_{60}$) caused significant increase in seed yield over P and S levels alone during first year. All the treatments were significantly superior to control and farmers' practice and farmers' practice was also significantly superior to control. Addition of compost to $P_{40}S_{30}$ resulted in significant increase in seed yield over $P_{40}S_{30}$ (T_2) the same was the result with addition of compost to $P_{60}S_{45}$ but addition of compost to $P_{80}S_{60}$ did not caused significant increase in seed yield. Addition of PSB had no significant effect when added to P and S levels except at $P_{60}S_{45}$. Combined application of compost + PSB to $P_{40}S_{30}$, $P_{60}S_{45}$ and $P_{80}S_{60}$ gave significant increase in yield throughout. $P_{80}S_{60}$+ Compost + PSB (2610.50 and 2656.23 kg ha^{-1}) was the highest yielding treatment during both the years.

It is indicated that the yield was almost doubled by combined use of $P_{80}S_{60}$+ compost + PSB over control during both the years. Barring a few exceptions the effects of compost and PSB along with P and S fertilizers resulted in significant increase in seed yield. The increase in the yield due to application of phosphorus might be ascribed to its fundamental role in photosynthesis, energy transformation through coupled phosphorylation/

dephosphorylation guided by ATP which is also the energy currency of the cell. The presence of phosphate in RNA and DNA which are signaling molecule for protein synthesis guides the type of protein formed suited for the system of plant. The phospholipids are integral part of cell, cell organelle membranes in the form of protein-lipoid double layer, phosphates regulates the translocation of simple sugars, minerals and waters from soil solution and provide drought resistance to the plant. The increase in seed yield of oilseed crops on addition of phosphorus had also been reported by Singh *et al*. (2009), Deo and Khandelwal (2009) and Yadav *et al*. (2005). The role of compost in the alround improvement of soil, crop and environment is well known and it is one of the most important options of IPNM practices. Addition of organic matter also results in carbon and phosphate sequestration in the soil. Phosphate solubilizing bacteria involve negligible cost but increases phosphate availability by secreting certain organic acids and solubilizing enzymes. They also secret certain growth promoting substances for plants. Based on these fundamental roles in increasing the crop yields, it is evident that higher yield obtained in the present study is convincing. Several investigators have reported increase in seed yield due to these IPNM components in mustard (Singh *et al*., 2014, Milkha and Aulakh, 2010, Tripathi *et al*., 2010 and Singh *et al*., 2008). In the present study efforts have been made for partitioning the contribution of IPNM components which revealed that application of $P_{80}S_{60}$ gave 108.71% increase in yield over control (Fig.1). Addition of compost increased 3-6% in yield over P and S treatments. Increase in yield with PSB was from about 2-5% and combined use of compost + PSB increase the yield by 4-10% over P and S levels. $P_{80}S_{60}$+ compost + PSB results an increase of 119.37% yield over control and 85.17% over farmers' practice and this was the best treatment in the present study during both the years. The present findings are corroborated by the findings of Singh and Pal 2011.

TABLE 1: Seed yield (kg ha^{-1}) of mustard

Tr. Code	Treatment Combinations	Mean		Mean of two year (% increase over control)
		2010-11	2011-12	
T_1	Control	1210.95	1190.20	-
T_2	$P_{40}S_{30}$	2016.45	2025.31	68.33
T_3	$P_{40}S_{30}$ + Compost	2125.85	2144.70	77.87
T_4	$P_{40}S_{30}$ + PSB	2116.55	2135.40	77.09
T_5	$P_{40}S_{30}$ + Compost + PSB	2143.50	2165.20	79.45
T_6	$P_{60}S_{45}$	2280.50	2295.60	90.59
T_7	$P_{60}S_{45}$+ Compost	2410.00	2430.10	101.59
T_8	$P_{60}S_{45}$+ PSB	2395.50	2408.90	100.10
T_9	$P_{60}S_{45}$+ Compost + PSB	2515.90	2540.80	110.61
T_{10}	$P_{80}S_{60}$	2495.50	2515.60	108.71
T_{11}	$P_{80}S_{60}$+ Compost	2560.00	2585.33	114.30
T_{12}	$P_{80}S_{60}$+ PSB	2540.00	2555.12	112.21
T_{13}	$P_{80}S_{60}$+ Compost + PSB	2610.50	2656.23	119.37
T_{14}	Farmers' Practices ($N_{30}P_{50}$)	1417.70	1426.42	18.45
	SE(d) ±	56.27	53.69	
	CD at 5%	115.70	110.38	

FIGURE1: Percentage Increase of yield over control

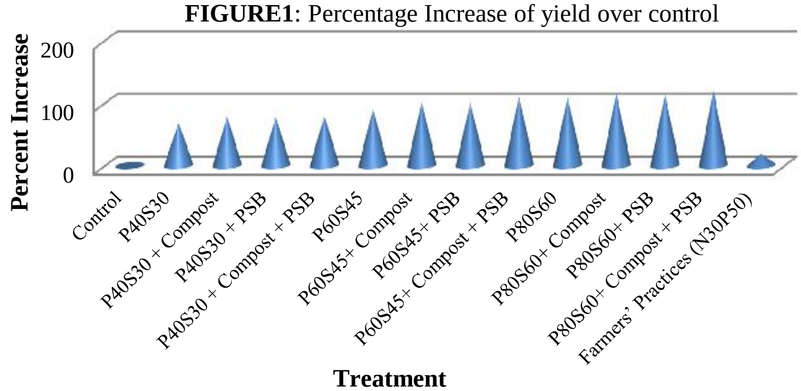

TABLE 2: Number of siliqua plant^{-1} in mustard

Tr. Code	Treatment Combinations	Mean	
		2010-11	2011-12
T_1	Control	217.97	214.23
T_2	$P_{40}S_{30}$	325.96	330.55
T_3	$P_{40}S_{30}$ + Compost	360.65	344.04
T_4	$P_{40}S_{30}$ + PSB	380.97	349.55
T_5	$P_{40}S_{30}$ + Compost + PSB	365.83	350.99
T_6	$P_{60}S_{45}$	399.49	399.20
T_7	$P_{60}S_{45}$+ Compost	433.80	420.00
T_8	$P_{60}S_{45}$+ PSB	421.19	435.40
T_9	$P_{60}S_{45}$+ Compost + PSB	441.00	440.28
T_{10}	$P_{80}S_{60}$	420.19	431.98
T_{11}	$P_{80}S_{60}$+ Compost	435.00	455.35
T_{12}	$P_{80}S_{60}$+ PSB	445.45	469.92
T_{13}	$P_{80}S_{60}$+ Compost + PSB	469.89	483.12
T_{14}	Farmers' Practices ($N_{30}P_{50}$)	232.18	256.75
	SE(d) ±	9.48	13.91
	CD at 5%	19.50	28.60

Number of siliqua plant^{-1}

The data in Table 2 showed all the treatments were significantly superior to control except T_{14} (farmers' practice). Each increase in phosphorus and sulphur levels resulted in significant increase in number of siliqua plant^{-1}. Addition of compost to P and S levels also gave significantly higher value than P and S combinations without compost except $P_{80}S_{60}$. Addition of PSB also gave significantly higher value than P and S combinations. Addition of compost and PSB to P and S combinations gave the highest (469.89) number of siliqua ($P_{80}S_{60}$+ Compost + PSB) during first year. During the second year the results followed the same trend as described for first year except that the farmers' practice (T_{14}) was also significantly had higher number of siliqua over control. Highest number (483.12) of siliqua plant^{-1} was again found in $P_{80}S_{60}$+ Compost + PSB treatment.

Number of seeds siliqua^{-1}

As shown in Table 3 the number of seeds siliqua^{-1} varied from 7.62-16.00 and lowest and highest value given by control and $P_{80}S_{60}$+ PSB. $P_{80}S_{60}$+ Compost + PSB gave the next highest value of 15.30 which was significantly lower than that of $P_{80}S_{60}$+ PSB. Farmers' practice also gave significantly higher number than control. The number increased with increasing levels of P and S significantly. Addition of compost also gave higher values than P and S combinations but the differences were non significant. Addition of PSB also increased seeds number significantly over P and S combinations at all levels. PSB appeared to be more effective in this respect than compost.

During second year all the treatments including farmers' practice performed significantly better than control. Increasing levels of P and S resulted in linear and significant increase in seeds number up to $P_{60}S_{45}$ but it was non significant at $P_{80}S_{60.}$ Addition of compost to P and S treatments did not caused significant increase in seeds number. A number of investigators have observed increases in these attributes in mustard crop *viz.* Tripathi *et al*. (2011),Chaurasia *et al.* (2009), Ramesh *et al.* (2009) and Kashved *et al.* (2010). The results of present study are in agreement with the findings of above workers.

TABLE 3: Number of seeds siliqua^{-1}in mustard

Tr. Code	Treatment Combinations	Mean	
		2010-11	2011-12
T_1	Control	7.62	7.49
T_2	$P_{40}S_{30}$	10.70	11.25
T_3	$P_{40}S_{30}$ + Compost	10.80	11.20
T_4	$P_{40}S_{30}$ + PSB	12.25	11.40
T_5	$P_{40}S_{30}$ + Compost + PSB	13.50	13.00
T_6	$P_{60}S_{45}$	13.40	14.20
T_7	$P_{60}S_{45}$+ Compost	14.18	14.00
T_8	$P_{60}S_{45}$+ PSB	15.09	14.55
T_9	$P_{60}S_{45}$+ Compost + PSB	14.90	15.00
T_{10}	$P_{80}S_{60}$	14.60	15.00
T_{11}	$P_{80}S_{60}$+ Compost	15.10	16.00
T_{12}	$P_{80}S_{60}$+ PSB	16.00	15.85
T_{13}	$P_{80}S_{60}$+ Compost + PSB	15.30	15.90
T_{14}	Farmers' Practices ($N_{30}P_{50}$)	8.93	8.98
	SE(d) ±	0.47	0.55
	CD at 5%	0.98	1.13

TABLE 4: Correlation of yield attributing characters with seed yield

Character	2010-11		2011-12	
	r value	Regression Equation	r value	Regression Equation
Siliqua plant^{-1}	0.9877	Y=130.2768+5.4238X	0.9786	Y=79.6914+5.63X
Seeds siliqua^{-1}	0.9545	Y=171.09+155.9672X	0.9646	Y=167.16+156.3195X

Correlation studies

Number of siliqua plant^{-1} and number of seeds siliqua^{-1}(Table-4) were correlated with yield and the correlations were positive and highly significant for both years and regression equations was also calculated which fitted well in the scattered diagram. Observed values converged around the assumed value in straight line, indicating that these characters had direct and intimate bearing on the seed yield. High correlations between the yield attributes and yield indicated the intimate positive relationship between these characters and yield. Similar results have also been reported by Rana and Rana (2003).

Oil content

During first year oil content varied from 39.00 - 42.55% in control and $P_{80}S_{60}$ +compost + PSB (Table- 5). $P_{40}S_{30}$ + compost, $P_{40}S_{30}$ + PSB and $P_{40}S_{30}$ + compost + PSB resulted in significantly higher oil content over $P_{40}S_{30}$. But addition of compost or PSB to $P_{60}S_{45}$ did not result in a significant increase in oil content over $P_{60}S_{45}$. However, $P_{60}S_{45}$ + compost + PSB was significantly superior to $P_{60}S_{45}$. Addition of PSB to $P_{80}S_{60}$ and $P_{80}S_{60}$ + compost + PSB gave significantly higher oil content than $P_{80}S_{60}$. During second year, increasing levels of P and S resulted in significant and linear increase in oil content. In the present investigation the oil content was significantly increased by combined application of phosphorus and sulphur and also with conjoint use of compost and PSB with different levels of P and S. Significant increase in oil content was observed during both the years and maximum increase was obtained in $P_{80}S_{60}$ + compost + PSB which was 3.55% and 5.5% higher over control during the first and second year respectively. This is a result of major quality improvement in the crop under IPNM treatments. Several workers have reported increase in oil content of mustard due to application of P, S, compost and PSB (Chand, 2007, Nagdive *et al*., 2007 and Singh and Singh, 2006).

TABLE 5: Oil content (%) in mustard seeds

Tr. Code	Treatment Combinations	Mean	
		2010-11	2011-12
T_1	Control	39.00	37.50
T_2	$P_{40}S_{30}$	40.00	40.00
T_3	$P_{40}S_{30}$ + Compost	40.50	40.20
T_4	$P_{40}S_{30}$ + PSB	40.40	40.50
T_5	$P_{40}S_{30}$ + Compost + PSB	41.00	42.30
T_6	$P_{60}S_{45}$	41.50	42.00
T_7	$P_{60}S_{45}$+ Compost	41.80	42.50
T_8	$P_{60}S_{45}$+ PSB	41.70	42.00
T_9	$P_{60}S_{45}$+ Compost + PSB	42.00	42.80
T_{10}	$P_{80}S_{60}$	41.80	42.50
T_{11}	$P_{80}S_{60}$+ Compost	42.00	42.70
T_{12}	$P_{80}S_{60}$+ PSB	42.24	42.70
T_{13}	$P_{80}S_{60}$+ Compost + PSB	42.55	43.00
T_{14}	Farmers' Practices ($N_{30}P_{50}$)	39.90	37.90
	SE(d) ±	0.19	0.21
	CD at 5%	0.38	0.43

Economics

Benefit cost (B: C) ratio reported as gross return upon gross cost varied from 2.17 – 3.34 (Table-6) and the highest B: C ratio was observed in $P_{80}S_{60}$ +PSB closely followed by $P_{80}S_{60}$. $P_{80}S_{60}$+ Compost + PSB gave a B: C ratio of 3.04 due to increase in gross cost in relation to gross return. In any case the treatments were highly remunerative and value cost ratio (VCR) which is an expression of net return divided by gross cost showed that the economic benefit excluding the cost of experimentation varied between 1.17 - 2.34 indicated that 2.34 times net benefit over the cost involved. The treatments had economic viability in absolute term. The highest VCR was observed in $P_{80}S_{60}$ + PSB and lowest in control.

There are two considerations in the economic implications, the yield maximization against lower profit and economic maximization at the cost of productivity. The higher productivity means the higher food availability with a marginal sacrifice of monetary return. The best treatment gave a VCR value of 2.04, but the production was higher therefore this should be preferred. These results are in agreement with those of Singh *et al*. (2014), Tripathi *et al*. (2011), and Chaurasia *et al*. (2009).

TABLE 6: Economic analysis of IPNM treatments (Mean of two year)

Tr. Code	Treatment Combinations	Gross cost	Gross return	Net return	B:C ratio	VCR
T_1	Control	15480	33638	18158	2.17	1.17
T_2	$P_{40}S_{30}$	19630	56703	37073	2.88	1.88
T_3	$P_{40}S_{30}$ + Compost	22505	59925	37420	2.66	1.66
T_4	$P_{40}S_{30}$ + PSB	19830	59660	39830	3.00	2.00
T_5	$P_{40}S_{30}$ + Compost + PSB	22705	60470	37765	2.66	1.66
T_6	$P_{60}S_{45}$	20408	64198	43790	3.14	2.14
T_7	$P_{60}S_{45}$+ Compost	23282	67914	44632	2.91	1.91
T_8	$P_{60}S_{45}$+ PSB	20608	67399	46791	3.27	2.27
T_9	$P_{60}S_{45}$+ Compost + PSB	23482	70968	47485	3.02	2.02
T_{10}	$P_{80}S_{60}$	21184	70319	49134	3.31	2.31
T_{11}	$P_{80}S_{60}$+ Compost	24059	72194	48135	3.00	2.00
T_{12}	$P_{80}S_{60}$+ PSB	21384	71484	50099	3.34	2.34
T_{13}	$P_{80}S_{60}$+ Compost + PSB	24259	73940	49681	3.04	2.04
T_{14}	Farmers Practices ($N_{30}P_{50}$)	17256	39896	22640	2.31	1.31

CONCLUSION

$P_{80}S_{60}$ +compost + PSB gave the highest yield of 2610.50 kg ha^{-1} and 2656.23 kg ha^{-1} during first and second year respectively.The best treatment gave 115.57 % and 123.17% increase in seed yield over control during first and second year respectively. It also gave 84.13% and 86.21% increase over farmers' practice during first and second year respectively.

RECOMMENDATION

It is recommended that nutrient supply to crops through IPNM is restoring the soil fertility and improving soil properties. Nutrient management in mustard through IPNM will be gainful preposition.

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