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YIELD, NUTRIENT UPTAKE AND SOIL FERTILITY OF MAIZE (*ZEA MAYS* L.) AS INFLUENCED BY VARYING NUTRIENT MANAGEMENT PRACTICES UNDER TEMPERATE CONDITIONS OF KASHMIR VALLEY, INDIA

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Abstract

Field experiments were conducted at Langate cluster of National Agriculture Innovation Project (SRLS-3) Kupwara during two *kharif* seasons of 2008 and 2009 to work out the influence of varying nutrient management practices on maize crop. The experiment comprised of seven integrated nutrient management practices laid in a randomised block experimental design. Application of 100% RDF(NPK)+vermicompost @ 3 tonnes per hectare recorded maximum kernels per cob, number of cobs per meter square, thousand grain weight, cob length and grain yield per hectare (3.26 quintals). Highest nutrient uptake 95.1, 20.8 and 84.1 kgs of NPK respectively was observed with the application of 100% NPK+ 3 Tonnes vermicompost per hectare. however the findings also revealed that vermicompost application @ 5.5 tonnes per hectare+farm yard Manure(FYM)@5.5 tonnes per hectare to maize crop recorded the soil availability of N, P and K status of 394.8,21.37 and 169.8 kgs. per hectare respectively statistically highly significant than the check.

Key words : Nutrient management, maize, vermicompost, yield, Kupwara.

Introduction

Maize (*Zea mays* L.) is the most versatile crop with wider adaptability in varied agro-ecological conditions. It has high genetic yield potential among the food grain crops. Globally, it is cultivated on nearly 150 million hectares in about 160 countries having wider diversity of soil, climate and management practices that contribute nearly 37% in the global grain production. In India, maize is the third most important food crop after rice and wheat. It is cultivated in 8.12 million hectares under a wide range of agro ecological conditions. It contributes nearly 8% in the national food basket and more than rupees 100 billion to the agricultural GDP at current prices apart from providing employment over 100 million man days at the farm and downstream agriculture and industrial sector. Its cultivation is also most predominant in temperate hill ecosystem. Maize has been a potential crop in summer (*kharif*) season due to its adaptability and ability to exploit residual moisture. The productivity of maize in hills is lower than the national average due to various factors including improper nutrient management. This crop is a nutrient responsive, soil exhaustive and a heavy feeds thus depleting soil fertility extensively. Poor recycling of organic resources also leads to emergencies of multiple nutrient deficiencies (Kumar, 2008). Hence, judicious nutrient management planning in maize cultivation is a prerequisite for sustainability. Keeping in view the facts aforementioned, present investigation was conducted to work out the possible response of maize crop to various integrated nutrient management practices and its influence on the soil status under the north western Himalayan conditions of India.

Materials and Methods

Field investigations were carried out during kharif seasons of 2010 and 2011 in maize cultivation at the demonsrtration plot adopted under national agriculture innovation project-3 SRLS in langate block 32.5^{0}N latitude and 74.5^{0}E longitude at 2658 metres above msl) of district Kupwara , Jammu and Kashmir. The initial soil status releaved medium organic carbon (0.8), N (342 kgs/ha), P (18 kgs/ha) and available K (156kgs/ha) with pH reaction of 7.9.

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The treatments comprised seven combinations **T_1** (Control), **T_2** (100% NPK @ 60:60:30 kgs per hectare), **T_3** 100% NPK+Vermicompost 3 tonnes per hectare), **T_4** (100% NPK + farm yard manure 3tonnes / haectare), **T_5** (50% NPK+vermicompost 3 tonnes / hextare) and **T_6** (50%NPK + 3 tonnes farmyard manure, **T_7** vermicompost @ 5.5 tonnes per hectare + farmyard manure @5.5 tonnes per hectare). The average NPK content in FYM and Vermicompost on dry weight basis were 0.88, 0.22., 0.85 and 1.6, 1.0, 1.0 respectively. The treatments as per standard methods were applied in the plots of maize using cultivar "C-8" following the randomised block design.

Plant samples were analysed for total N using a micro-kjeldahl method, while total P and K were determined as per procedure described by Prasad *et al.* (2006). The post harvest soil samples were collected from 0-20 centimetre depth for analysing available nutrient status. Soil samples were analyses for alkaline permanganate oxidable N,0.5 m $NAHCO_3$-extractable P and in NH_4oac-exchangable K.

Results and Discussion

Yield attributes

Application of 1005NPK + vermicompost @ 3 tonnes /ha recorded maximum kernels per cob, number of cobs /m^2, 1000 grain weight and cob length followed by 100% NPK+FYM @ 3 tonnes/ha. The response of combined application of vermicompost 5.5 tonnes per hectare + farm yard manure 5.5 tonnes per hectare on yield attributes were statistically found at par with 100% NPK alone (table 1). Increase in yield attributes might be due to increase in photosynthetic area, dry matter accumulation and also due to translocation of photosynthates towards sink, in which potassium plays a vital role and nitrogen and phosphorous are required for proper development. These are in accordance with the findings of Rather and Sharma (2009), Dahiya *et al.* (2008), Sharma *et al.* (2008), Khan *et al.* (2008), Shukla and Warsi (2000) and Singh *et al.* (1999). Thus, readily available NPK and micro nutrients available in organic nutrient sources might have influenced the yield attributes of the crop.

Grain yield

Maximum grain yield (3.26 tonnes per hectare) was recorded with combined application of 100% NPK + Vermicompost @ 3 tonnes per hectare followed by 100% NPK + FYM @ 3 tonnes per hectare. However, the two treatments were found at par with 50% NPK + Vermicompost or FYM 5.5 tonnes per hectare (Table 3). Pooled grain yield obtained with integration of 100% NPK+vermicompost 3 t/ha was 103% and 9.6% higher than the control and recommended NPK, respectively. Higher grain yield with combined application of inorganic and organic sources of nutrients could be ascribed to efficient utilization of nutrients from combined sources compared to the single source. These findings are in agreement with the findings of Nanjappa *et al*. (2001) and Mahala *et al*. (2006). Organic manures like FYM also supply nutrients beneficial to the crop growth and productivity (Das *et al*., 2004). Substitution of 100% inorganic fertilizers with Vermicompost 5.5 tonnes per hectare + FYM@ 5.5 t/ha gave grain yield similar to 100% NPK. Organic manures act as nutrient reservoir and upon decomposition produces organic acids, thereby absorbed ions are released slowly for the entire growth period leading to higher yields as reported by Kumar *et al.* (2005).

Nutrient uptake

Highest nutrient uptake (95.1, 20.8 and 84.1 kgs N P and K, respectively) was observed with the integration of 100% NPK + Vermicompost @ 3 tonnes/ha in maize crop. It was followed by 100% NPK + FYM 3 tonnes per hectare in which nutrient uptake was observed to the tone of 93.3, 20.1 and 82.8 kgs N, P and K respectively

Table 1 : Effect of organic and inorganic sources of nutrients on available nutrients(kg/ha) and organic Carbon(%) at final harvest of maize crop (2 years pooled data).

	Treatment combinations	N(Kgs/ha.)	P(Kgs/ha)	K(Kgs/ha.)	Organic Carbon(%)
T_1	Absolute control	338.1	17.5	151.7	0.82
T_2	100% NPK(50:50:30 Kg/ha)	387.2	19.42	165.7	0.90
T_3	100% NPK+Vermicompost@3t/ha	391.4	20.20	164.5	1.10
T_4	100% NPK+FYM@3t/ha	389.7	19.38	167.2	1.14
T_5	50% NPK+Vermicompost@5.5t/ha	393.5	20.36	167.7	2.10
T_6	50% NPK+FYM@5.5t/ha	392.2	20.17	166.4	2.08
T_7	Vermicompost@3t/ha+ FYM@3t/ha	394.8	21.35	169.8	2.07
	$CD_{(0.05)}$	17.1	1.55	NS	0.11

Table 2 : Effect of organic and inorganic sources of nutrients on nutrient uptake (kg/ha) by maize crop (2 years pooled data).

	Treatment combinations	N(Kgs/ha.)	P(Kgs/ha)	K(Kgs/ha.)
T_1	Absolute control	33.0	10.3	27.8
T_2	100%NPK(50:50:30 Kg/ha)	82.7	18.0	75.9
T_3	100%NPK+Vermicompost@3t/ha	95.1	20.8	84.1
T_4	100%NPK+FYM@3t/ha	93.3	20.1	82.8
T_5	50%NPK+Vermicompost@5.5t/ha	92.2	19.9	82.3
T_6	50%NPK+FYM@5.5t/ha	89.9	19.2	80.9
T_7	Vermicompost@3t/ha+ FYM@3t/ha	85.1	18.9	79.3
	$CD_{(0.05)}$	11.28	2.47	6.11

Table 3 : effect of organic and inorganic sources of nutrients on yield attributes and yield of maize crop(2 years pooled Data)

	Treatment combinations	Cobs/m^2	Cob length (cm)	No. of grains per cob	1000 grain weight (grams)	Grain yield (t/ha.)
T_1	Absolute control	5.15	8.25	140.8	185.6	1.63
T_2	100%NPK(50:50:30 Kg/ha)	6.90	13.93	325.9	228.9	2.98
T_3	100%NPK+Vermicompost@3t/ha	7.50	16.92	385.8	262.1	3.26
T_4	100%NPK+FYM@3t/ha	7.33	16.69	267.3	259.9	3.21
T_5	50%NPK+Vermicompost@5.5t/ha	7.45	16.00	360.7	259.2	3.15
T_6	50%NPK+FYM@5.5t/ha	7.00	15.93	355.0	254.2	3.11
T_7	Vermicompost@3t/ha+ FYM@3t/ha	7.15	14.55	333.5	251.0	2.89
	$CD_{(0.05)}$	0.38	2.5	30.0	7.8	0.31

(table 2) this might be due to the fact that combined application of organic and inorganic sources of nutrients modified the soil environment, besides providing the physical properties of soil and also the slow microbial decomposition of humus gradually increases that nutrient availability during cropping period, which was manifested in higher nutrient uptake by the maize. This is in confirmation with the findings of Maitra *et al*. (2008).

Soil fertility

At final harvest, highest soil fertility in terms of available N, P and K was observes when vermicompost 5.5 tonnes per hectare or FYM 5.5 tonnes per hectare was applied in maize (table 3). This was at par with the available NPK status of all other treatment combinations except control, which recorded significantly lower NPK status. Application of vermicompost 5.5 tomes per hectare + FYM 5.5 t/ha in maize recorded N, P and K status of 394.8, 21.37 and 169.8 kgs, respectively, which was significantly higher than the control. Increase in available NPK might be due to the direct addition of N through vermicolmpost or FYM and increased microbial growth which might have converted organically bound N to inorganic form. Increase in available phosphorous was due to the fact that organic materials form a cover on seasquioxides and thus reduces the phosphate, fixing capacity of the soil and increases solubilisation of the native soil pool as reported by Kumar *et al.* (2005).

Highest soil organic carbon content at final harvest was recorded with 50%NPK + Vermicompost @ 5.5 t/ha (2.10), which was higher than control and recommended NPK. Data presented in table 3 revealed that the treatments with organic manures with or without fertilizers recorded the similar organic carbon value. Improvement in soil organic carbon due to addition of organic manures compared to recommended NPK alone was also reported by Ramesh *et al*. (2009).

The study on the integrated nutrient management strategy revealed that application of full dose of inorganic fertilizers along with vermicompost @ 3 tonnes per hectare to maize not only enhanced productivity of maize by 90% and 13.4% over the control and Recommended NPK, respectively, but also improved soil fertility in terms of higher available N, P and organic carbon.

References

Das, A., M. Prasad, Y. S. Shivay and K. M. Subha (2004). Productivity and sustainability od cotton (*Gossipium hisrutum* L.)- wheat (*Triticum aestivum* L) cropping system as influenced by prilled urea, farmyard manure and Azotobacter. *Journal of Agronomy and Crop Science*, **190** : 298-304.

Dahiya, D. S., S. S. Dahiya, O. P. Lathwal, S. Sharma and R. S. Sheron (2008). Integrated nutrient management in wheat under rice-wheat cropping system. *Haryana Journal of Agronomy*, **24(1&2)** : 51-54.

Khan, N. A., M. P. Fulller and F. S. Baloch (2008). Effect of soil applied zinc sulphate on wheat (*Triticum aestivum* L.) grown on a calcerious soil in Pakistan. *Cereal Research Communications*, **36(4)** : 571-582.

Kumar, A., R. C. Gautam, R. Singh and K. S. Rana (2005). Growth yield and economics of maize (*Zea mays*)-wheat (*Triticum aestivum* L) cropping sequence as nfluenced by integrated nutrient management. *Indian Jr. of Agri Sci.*, **75(11)** : 709-711.

Kumar, A. (2008). Direct and Residual effect of nutrient management in maize (*Zea mays*)-wheat (*Triticum aestivum*) ctopping system. *Ind. Jr. of Agronomy*, **53(1)** : 37-41.

Mahala, H. L., M. S. Shakatawat and R. K. Shivram (2006). Direct and residual effect of sources and levels of phosphorous levels and Farmyard manure in Maize-Mustard cropping sequence. *Indian Jr. of Agro*., **51(1)** : 10-13.

Maitra, D. N., S. K. Sarkar, S. Saha, M. K. Tripathi, B. Majumdar and A. R. Saha (2008). Effect of phosphorous and farmyard Manure applied to sunnhemp (*Crotalaria juncia*) on yield and nutrient uptake of sunnhemp-wheat (*Triticum aestivum*) cropping system and fertility statuds in a typic Ustocrepty of Utterpradesh. *Ind. Jr. of Agri. Sci.*, **78** : 70-74.

Nanjappa, H. V., B. K. Ramchandrappa and B. Mallikarjuna (2001). Effect of integrated nutrient management on yield and nutrient balance ion wheat (*Zea mays*). *Ind. Jr. of Agron*., **46** : 698-701.

Prasad, R., Y. S. Shivay, D. Kumar and N. S. Sharma (2006). *Learning by doing exercise in soil fertility*. Div. of Agronomy, IARI, New Delhi.

Ramesh, P., N. R. Panwar, A. B. Singh and S. Ramana (2009). Effect of organic nutrient management practices on the production potential, nutrient uptake, soil fertility, soil quality, input uses efficiency and economics of mustard (*Brassica juncia*). *Ind. Jr. of Agri. Sci*., **79(1)** : 40-44.

Rather, S. A. and N. L. Sharma (2009). Effect of integrated nutrient management on yield and nutrient uptake by wheat and their residual effect on succeeding mustard crop in mung-wheat cropping system. *Int. Jr. of Agri. Sci*., **5(2)** : 494-496.

Sharma, K. M., D. D. Sharma, K. B. Shukla and B. Upadhyay (2008). Growth partitioning and productivity of wheat as influenced by fertilization and foliar application of bio regulators. *Ind. Jr. of Plant Physio*., **13(4)** : 387-393.

Shukla, S. K. and A. S. Waris (2000). Effect of sulphur and micronutrients on growth, nutrient content and yield of wheat (*Triticum aestivum*). *Ind. Jr. of Agri. Res*., **34(3)** : 203-205.

Singh, N. B. and K. K. Verma (1999). Integrated nutrient management in rice-wheat cropping sequences. *Oryza*, **36(2&3)** : 171-172.