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NUTRIENT UPTAKE AND SOIL FERTILITY BY MAIZE AS INFLUENCED BY DETASSELING AND NUTRIENT MANAGEMENT

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Abstract

A field experiment on effect of detasseling and nutrient management on growth and yield of maize (*Zea mays* L.) was carried out at Agronomy Farm, Nagpur during 2013-14. The experiment was laid out in FRBD with ten treatment combinations and replicated thrice. The experimental site was selected on the merit in respect of suitability of land for maize cultivation with uniform fertility and topography. The experiment on Vertisol having organic carbon 0.52%, pH 7.76, available N, P and K 187.60, 20.32 and 333.67 kg ha^{-1}, respectively. Therefore, significantly increases in soil fertility by increases in fertilizer levels and nutrient uptake of nitrogen, phosphorus and potassium significantly increases by the applying varying fertilizer doses and tasseling treatments.

Key words : Maize (*Zea mays* L.), grain yield, nutrient, soil fertility, biofertilizer.

Introduction

Maize is one of the most important cereal crop in India as well as in the world. It is a miracle crop. There is no cereal on the earth, which has so immense potentiality and that is why it is called "Queen of cereal". Maize is originated in Mexico in Central America. Its introduction in India probably occurred in the beginning of the seventeenth century, during the early days of the East India Company (Singh, 1999). Globally maize occupied third position next to wheat and rice in its consumption. It contributes about 20 per cent of the world's total cereal production. It is one of the most versatile crops in nature, which can be grown over a wide range of climatic conditions and has acquired a dominant role in the farming sector. Maize is warm weather loving crop and can be successfully grown in a area receiving an annual rainfall of 60 cm, with well distributed throughout its growing period.

Maize is used as food crop by rural people in the form of bread and gruel. Maize grain contain about 72% starch, 10% protein, 4.8% oil, 5.8% fibre and 3.0% sugar. It is a source of raw material for industry, where it is being extensively used for the preparation for corn starch, corn oil dextrose, corn syrup, corn flakes cosmetics, wax, alcohol and tanning material for leather industry.

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Maize is cultivated in India on an average of 8.6 million hectares with a production of 22.3 million tones, (Anonymous, 2013). Maharashtra is one of the important cereal crops growing state in India. In Maharashtra, maize occupied an area of 8.22 lakh hectares with the production of 18.24 lakh tones (Anonymous, 2012).

The secure the food development of increasing population India from 200 millions tones in 2000 to about 300 tones by year 2020 to achieve this target food grains production must be increase @ 5 millions tones per year over the next decades.

Detasseling is important for corn production due to the fact that it reduces the completion of light moisture and nutrient. Due to Detasseling also increased the cob diameter, cob length, number of grain cob^{-1}, test weight, grain yield and straw yield.

Maize is heavy feeder of nutrient and due to this proper nutrient management is one of the most important practice to increase production in maize. Maize crop gives good response to nutrient and nutrient application to maize has showed significant indication in increasing the plant height, dry matter accumulation, cob diameter, cob length, number of grain cob^{-1}, test weight, grain yield and straw yield. Combination of nutrient with biofertilizer increase the growth parameter and yield attributes and also total uptake of nutrient.

Complete tassel removal may have reduce the competition between tassels and ears for the plant nutrient but, it increase the radiant flux to the leaves. When tassel were removed and re-inserted in the whorl, the tassel no longer compare for plant nutrient but still intercepts solar radiation (Hunter *et al*., 1969).

Further lack of proper nutrient management is one of the major causes of low yield. Maize crop gives good response to fertilizers and fertilizer application to maize has given significant indication in increasing yield. It was reported that the stover and grain yield of maize increased significantly with the increasing N and P from 0-150 and 0-80 kg ha^{-1}, respectively (Kumar and Singh, 2003).

Materials and Methods

A field experiment was conducted during *kharif* season of 2013-2014 at Research Farm, Department of Agronomy, College of Agriculture Nagpur, Dr. P.D.K.V., Akola (M.S.), India. Nagpur is located at North latitude of 21^0 8' and East longitude of 79^0 4' having an elevation of 321 m above MSL and has subtropical climate. The climate is hot and slightly moist. The mean annual rainfall of Nagpur is 940 mm.

The experiment on Vertisol having organic carbon 0.52%, pH 7.76, available N, P and K 187.60, 20.32 and 333.67 kg ha^{-1}, respectively. Therefore, different soil moisture constants such as field capacity 32.66%, bulk density 1.32 dsm^{-1} and permanent wilting point 14.22%, respectively. The experiment consisting of ten treatments combination was carried out in three times replicated with factorial randomized block design. The treatments combinations of detassling (A) and nutrient management (B) were- (I) D_1-No detasseling (control), (II) D_2-Detasseling (after pollination), (I) F_1-100% RDF (120:60:30 kg NPK ha^{-1}), (II) F_2-125% RDF (150:75:37.5 kg NPK ha^{-1}), (III) F_3- 150% RDF (180:90:45 kg NPK ha^{-1}), (IV) F_4-100% RDF +PSB + Azotobactor and (V) F_5-125% RDF +PSB + Azotobactor.

The crop was sown at 60 cm × 20 cm spacing in 17 m^2 plot (3.6 m × 4.6 m) in fourth week of June and harvested in third week of October. The cultivation practices were followed as per the Guidelines of Crop Production Guide of Dr. Panjabrao Deshmukh Krishi Vidyapeeth Agriculture University. The fertilizer sources were urea for N (46% N), single super phosphate for P (16% P) and muriate of potash for K (60% K_2O). Nitrogen was applied as per treatments through urea in two splits *i.e.* ½ at sowing, ¼ at 30 days and ¼ at 50 days after sowing. Full dose of phosphorus and potash was applied at the time of sowing to all the plots as per treatment through single super phosphate and mutate of potash, respectively.

The maize seed was treated with thirum @ of 3 g kg^{-1} of seed before sowing in order to keep the seed free from soil borne diseases. The soil of experimental plot was vertisol, fairly uniform and levelled. Soil samples were collected randomly from experimental area at a depth of 0-30 cm with the help of screw auger. A composite sample was prepared and analyzed for physical and chemical properties.

Results and Discussion

Nutrient uptake (kg/ha)

Nitrogen uptake :

Data in respect of nitrogen uptake by grain and straw of maize as influence by different treatment are presented in table 1. In general, the nitrogen uptake by grain and straw was 75.93 kg ha^{-1} and 28.65 kg ha^{-1}, respectively.

Effect of detasseling : Data from table 1 revealed that detasseling recorded significantly more uptake of nitrogen in grain (78.25 kg N ha^{-1}) and straw (29.8 kg N ha^{-1}) over the no detasseling (73.61 kg N ha^{-1}) and (27.50 N kg ha^{-1}), in respect to grain and straw, respectively. Total uptake of nitrogen was maximum in detasseling treatment. The similar result was also reportedly by Singh (2010).

Effect of nutrient management : The nitrogen uptake in grain and straw of maize was significantly higher with application of 150% RDF (81.70 kg ha^{-1} and 31.87 kg ha^{-1}) as compared to 100% RDF (71.17 kg ha^{-1} and 26.04 kg ha^{-1}), 125% RDF (73.49 kg ha^{-1} and 27.01 kg ha^{-1}) respectively and were statistically at par with 125% RDF+PSB + Azotobacter (77.87 kg ha^{-1} 30.05 kg ha^{-1}) and 100% RDF+PSB+ Azotobacter 75.40 kg ha^{-1} and 28.27 kg ha^{-1}. The treatment 125% RDF+PSB+ Azotobacter also recorded significantly more nutrient uptake over 100% RDF and at par with 125% RDF. These results are in conformity with the finding of Singh and Sarkar (2001), Gajendra Singh *et al*. (2012) and Keerthi *et al.* (2013).

Higher total uptake of nitrogen was recorded by treatment of 150 RDF. The use of biofertilizer helped in making of nutrients available and thus uptake was more in grain and straw.

Interaction : The interaction effect due to detasseling and nutrient management on uptake of nitrogen in grain and straw was found to be non-significant.

Phosphorus uptake : Data in respect of phosphorus uptake by grain and straw of maize as influenced by

different treatments and are presented in table 1. In general, the phosphorus uptake by grain and straw was 10.48 kg P ha^{-1} and 10.75 kg P ha^{-1}, respectively.

Effect of detasseling : Data from table 1 revealed that detasseling recorded significantly more phosphorus uptake of 11.53 kg P ha^{-1} and 11.82 P kg ha^{-1} in respect of grain and straw, respectively over no detasseling. The similar result was also reportedly by Singh (2010).

Total uptake of phosphorus was higher in detasseling treatment (23.35 kg ha^{-1}) as compared to no detasseling.

Effect of nutrient management : Application of 150% RDF recorded significantly more phosphorus uptake of 11.76 kg P ha^{-1} and 12.20 kg P ha^{-1} by grain and straw, respectively over all other treatment except 125% RDF + PSB + Azotobacter. Treatment of 150% RDF and 125% RDF + PSB + Azotobacter were at par. This might due to more utilization of nutrient by the plant. These result are in conformity with the finding of Singh *et al*. (2012) and Keerthi *et al*. (2013).

Total uptake of phosphorus was maximum in 150% RDF treatment (23.96 kg ha^{-1}) than all other treatments.

Interaction : The interaction effect due to detasseling and nutrient management on uptake of phosphorus in grain and straw was found to be non-significant.

Potassium uptake :

Data in respect of potassium uptake by grain and straw of maize as influenced by different treatments are presented in table 1. In general, the potassium uptake by grain was 68.46 kg K ha^{-1} and straw 11.05 kg K ha^{-1}, respectively.

Effect of detasseling : Data from table 1 revealed that detasseling recorded significantly more uptake potassium in grain 11.56 kg ha^{-1} and straw 69.90 kg ha^{-1} over no detasseling 10.55 kg ha^{-1} and 67.02 kg ha^{-1} in respect of grain and straw respectively. The similar result was also reportedly by Singh (2010).

Maximum total of potassium was recorded by detasseling treatments (81.14 kg ha^{-1}) as compared to no detasseling (77.57 kg ha^{-1}).

Effect of nutrient management : The potassium uptake in grain and straw of maize was significantly higher with application of 150% RDF (12.84 kg ha^{-1}) and 71.45 kg ha^{-1} as compared to 100% RDF (9.58 kg ha^{-1}) and (65.23 kg ha^{-1}), and 125% RDF (10.38 kg ha^{-1}) and (66.30 kg ha^{-1}), respectively 125% RDF + PSB + Azotobacter was at par with 150% RDF treatment. The treatment 100% RDF + PSB + Azotobacter 125% RDF + PSB + Azotobacter recorded significantly more uptake of potassium over 100% RDF and at par with 125% RDF. These result are in conformity with the finding of Singh and Sarkar (2001), Singh *et al*. (2012) and Keerthi *et al*. (2013).

The use of biofertilizer made nutrient available from fertilizer effectively and due to this nutrient uptake was more in grain and straw. Higher total uptake of potassium was recorded by treatment of 150% RDF (84.29 kg ha^{-1}).

Interaction : The interaction effect due to detasseling and nutrient management on uptake of potassium in grain and straw was found to be non-significant.

Nutrient status of soil after harvest of maize

Available nitrogen :

Data pertaining to available nitrogen in the soil after harvest of maize as influence by different treatment are presented in table 2. The mean available nitrogen in the soil after harvest of maize was 222.06 kg ha^{-1}.

Effect of detasseling : Data from table 2 revealed that after harvest of crop detasseling treatment recorded significantly more available nitrogen in soil (229.98 kg ha^{-1}) over the no detasseling (214.14 kg ha^{-1}).

Nutrient management : Available nitrogen content in soil after harvest of maize was found increased significantly with each increase in the level of fertilizer to maize. Application of 150% RDF (243.14 kg ha^{-1}) to maize registered significantly higher nitrogen content in soil over the 100% RDF (198.33 kg ha^{-1}) and 125% RDF (215.82 kg ha^{-1}). However, 125% RDF + PSB + Azotobactor (229.24 kg ha^{-1}) and 100% RDF + PSB + Azotobactor (223.7 kg N ha^{-1}) were at par with 150% RDF. The treatment 125% RDF + PSB + Azotobactor was significantly at par with 125% RDF and 100% RDF + PSB + Azotobactor. These result are in conformity with the finding of Bhandari and Rawat (2004), Singh *et al*. (2012) and Keerthi *et al*. (2013). The biofertilizer were effective in making nutrients available in soil. Thus, help to maintain the soil fertility by increasing available nitrogen in soil.

Interaction : The interaction effect due to detasseling and nutrient management on available nitrogen in soil after harvest of maize was found to be non-significant.

Available phosphorus :

Data pertaining to available phosphorus in the soil after harvest of maize as influence by different treatment are presented in table 2. The mean available phosphorus in the soil after harvest of maize was 28.29 kg ha^{-1}.

Table 1 : Nitrogen, phosphorus and potassium uptake (kg ha^{-1}) influenced by various treatments.

Treatment	Nitrogen uptake (kg ha^{-1})		
	Nitrogen	Phosphorus	Potassium
A) Detasseling			
D_1- No detasseling (control)	101.11	19.11	77.57
D_2- Detassling	108.08	23.35	81.14
S.Em.±	-	-	-
CD at 5%	-	-	-
B) Nutrient management			
F_1- 100% RDF	97.21	19.21	74.81
F_2- 125% RDF	100.5	20.09	76.68
F_3- 150% RDF	113.57	23.96	84.29
F_4-100%RDF+ PSB +Azotobactor	103.67	20.89	79.78
F_5-125% RDF+PSB +Azotobactor	107.92	22.00	81.97
S.Em.±	-	-	-
CD at 5 %	-	-	-
Interaction			
S.Em.±	-	-	-
CD at 5%	-	-	-
GM	104.57	21.23	79.51

Effect of detasseling : Data from table 2 revealed that detasseling recorded significantly more available phosphorus in soil (29.17 kg ha^{-1}) over the no detasseling (29.39 kg ha^{-1}).

Nutrient management : Available phosphorus content in soil after harvest of maize was found to be increased significantly with each increase fertilizer level to maize. Application of 150% RDF to maize registered significantly higher available phosphorus content in soil (33.18 kg ha^{-1}) over all other nutrient level except 125% RDF + PSB + Azotobactor (31.34 kg ha^{-1}) being at par. The treatment 125% RDF + PSB + Azotobactor recorded more phosphorus content in soil significantly over 100% RDF and 100% RDF + PSB + Azotobactor at par. This might to be use of biofertilizer, which might have nutrient available more effectively. These result are in conformity with the finding of Bhandari and Rawat (2004), Singh *et al*. (2012) and Keerthi *et al.* (2013).

Interaction : The interaction effect due to detasseling and nutrient management on available phosphorus in soil after harvest of maize was found to be non-significant.

Table 2 : Available nitrogen, phosphorus and potassium (kg ha^{-1}) in soil after harvest of maize as influence by various treatments.

Treatment	Nitrogen uptake (kg ha^{-1})		
	Nitrogen	Phosphorus	Potassium
A) Detasseling			
D_1- No detasseling (control)	214.14	27.39	353.28
D_2- Detassling	229.98	29.17	396.43
S.Em.±	4.96	0.57	9.47
CD at 5%	14.76	1.70	28.15
B) Nutrient management			
F_1- 100% RDF	198.38	22.76	342.21
F_2- 125% RDF	215.82	26.38	358.73
F_3- 150% RDF	243.14	33.18	414.18
F_4-100%RDF+ PSB + Azotobactor	223.72	27.74	363.95
F_5-125% RDF +PSB + Azotobactor	229.24	31.34	395.21
S.Em.±	7.85	0.90	14.98
CD at 5%	23.34	2.69	44.51
Interaction			
S.Em.±	11.10	1.28	21.18
CD at 5%	NS	NS	NS
GM	222.06	28.29	374.86
Initial	187.60	22.32	333.67

Available potassium :

Data pertaining to available potassium in the soil after harvest of maize as influence by different treatment are presented in table 2. The mean available potassium in the soil after harvest of maize was (374. 86 kg ha^{-1}).

Effect of detasseling : Data from table 2 revealed that detasseling recorded significantly more available potassium in the soil after harvest of maize (396.43 kg ha^{-1}) over the no detasseling (353.28 kg ha^{-1}).

Nutrient management : Available potassium content in soil after harvest of maize was found to be increased significantly with each increase in the level fertilizer to maize. Application of 150% RDF to maize registered significantly higher potassium content in soil (414.18 kg ha^{-1}) over all other treatments except 125% RDF + PSB + Azotobactor (395.21 kg ha^{-1}) being at par with 150% RDF. The treatment 125% RDF + PSB + Azotobactor (395.21 kg ha^{-1}) recorded significantly more

potassium over 100% RDF (342.21 kg ha^{-1}). However, it was at par with 125% RDF (358.73 kg ha^{-1}) and 100% RDF + PSB + Azotobactor (363.95 kg ha^{-1}). The use of biofertilizer made nutrients available in soil effectively and due to this more nutrient available in soil. These result are in conformity with the finding of Bhandari and Rawat (2004), Singh *et al*. (2012) and Keerthi *et al.* (2013).

Conclusion

It can concluded that significantly increases in soil fertility by increases in fertilizer levels and nutrient uptake of nitrogen, phosphorus and potassium significantly increases by the applying varying fertilizer doses and tasseling treatments.

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