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Amit Kumar

Naini Agricultural Institute (NAI), Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad Uttar Pradesh, India

Abhinav Dayal

Department of Genetics and Plant Breeding, Naini Agricultural Institute (NAI), Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad Uttar Pradesh, India

PK Rai

Department of Genetics and Plant Breeding, Naini Agricultural Institute (NAI), Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad Uttar Pradesh, India

Kirti Ranjan Verma

Department of Genetics and Plant Breeding, Naini Agricultural Institute (NAI), Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Correspondence

Amit Kumar

Department of Genetics and Plant Breeding, Naini Agricultural Institute (NAI), Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad Uttar Pradesh, India

Effect of integrated nutrient management on seed quality characters in maize (*Zea mays* L.)

Amit Kumar, Abhinav Dayal, PK Rai and Kirti Ranjan Verma

Abstract

A lab experiment was conducted at the seed testing laboratory of Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad U. P. (India) to study the effect of integrated nutrient management on seed quality characters in maize. Nine treatment *i.e* T₀= Control, T₁= 100 per cent recommended dose of N,P,K, T₂= 25% RDF, T₃= FYM @ 10-15 tonnes per ha⁻¹, T₄= Bio fertilizer (Azotobacter 500 gm ha⁻¹ and PSB 500 gm ha⁻¹), T₅= 25 % RDF + FYM + Bio fertilizer, T₆= 25 % RDF + FYM, T₇= 25 % RDF + Bio fertilizer, T₈= FYM + Bio fertilizer replicated four times each were carried out in the plot in CRD design. Significant increase in seed quality characters (Germination per cent, root length, shoot length, seedling length, seedling fresh weight, seedling dry weight, vigour index I and vigour index II in maize) was observed with INM in comparison to other treatment combination. More over T₅ treatment (25 % RDF + FYM + Bio fertilizer) showed better result.

Keywords: Nutrient management, PSB, Azotobacter, FYM, quality, maize

Introduction

Maize has high genetic yield potential than other cereal crops. Hence it is called as 'miracle crop' and also as 'queen of cereals'. Being a C₄ plant, it is very efficient in converting solar energy in to dry matte. As heavy feeder of nutrient, maize productivity is largely dependent on nutrient management. Maize is one of the important cereal crops next only to wheat and rice in the world. In India it ranks fourth after rice, wheat and sorghum. Maize is being consumed both as food and fodder and also required by the various industries. It is a good source of carbohydrates, fat protein and some important vitamins and minerals.

Integrated plant nutrient management (INM) is the combined use of mineral fertilizers with organic resources such as cattle manures, crop residues, urban/rural wastes, composts, green manures and bio-fertilizers. Nitrogen is a component of protein, nucleic acids and other compounds essential for plant growth process. It is a major plant growth and yield determining nutrient required for maize production. Bio fertilizer or microbial inoculants are eco friendly, non-bulky, cheap and renewable sources of nutrients for plant. These inoculants render nutrients in available from and in adequate amounts which are otherwise inaccessible to the plants. The application of bio fertilizers also helps in improving biological activities of soil.

Material and Method

The present investigations were conducted during 2018 at the seed testing laboratory of Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Science, Allahabad U. P. (India) to study the effect of integrated nutrient management on seed quality characters in maize. Freshly harvested bulk seeds of maize three var. Sweety, Early Wonder and Sulabh-25 were utilized in this study. Between paper method is used in this experiment. The following seed treatment are used in experiment T₀= Control, T₁= 100 per cent recommended dose of N,P,K, T₂= 25% RDF, T₃= FYM @ 10-15 tonnes per ha⁻¹, T₄= Bio fertilizer (Azotobacter 500 gm ha⁻¹ and PSB 500 gm ha⁻¹), T₅= 25 % RDF + FYM + Bio fertilizer, T₆= 25 % RDF + FYM, T₇= 25 % RDF + Bio fertilizer, T₈= FYM + Bio fertilizer. Observation on seed quality characters viz. germination per cent, root length, shoot length, seedling length, seedling fresh weight, seedling dry weight, vigour index I and vigour index II are recorded after seven day of sowing. Germination per cent was recorded according to ISTA, 2011. Root length, shoot length and seedling length was recording with the help of scale. Seedling fresh weight was observed with the help of micro weighting machine. After observing the fresh weight seedling placed in oven for 24 hours at 105°C.

Vigour index was computed by using the formula as suggested by Abdul-Baki and Anderson (1973) ^[1], and expressed in whole number.

Results and discussion

The result obtained from the lab experiments conducted to study the effect of integrated nutrient management on seed quality characters in maize. The nine types of different treatment were applied through seed treatment and their effects were investigated on the important seed quality parameters of maize.

The data recorded on per cent germination of seed in the laboratory showed significant differences among different treatments for seed germination. The maximum seed germination (90.62%) was recorded in the treatment T₅ followed by T₈, T₇, T₆, T₅, T₄, T₃, T₁, T₂ and minimum seed germination was recorded in T₀ (80.83%). In terms of different variety early wonder (V₂) showed superior performance followed by V₃ and V₁. As far as interaction between variety and integrated nutrient management; the maximum germination percentage (92.62) was obtained from treatment T₁₅ (25% RDF + FYM + Bio fertilizer (Azotobacter + PSB) + Early Wonder) and the minimum germination percentage (79.25) remained from treatment T₁ Control + Sweety. Similar findings were reported by Haile (2013), Channabasanagowda *et al.* (2008) in maize. Availability of major nutrients like NPK at all the stages of crop growth is responsible for good

quality of seed. Minimum seed germination was recorded in control which may be ascribed to no application of essential nutrient.

The data recorded for root length, shoot length and seedling length of seed in the laboratory showed significant differences among different treatments for seed germination. The maximum root, shoot and seedling length (31.25, 21.91 and 53.00) was recorded in treatment T₅ followed by T₈, T₇, T₆, T₅, T₄, T₃, T₁, T₂ and minimum root, shoot and seedling length (21.83, 12.58 and 34.58) was recorded in treatment T₀. Variety Early wonder recorded maximum root, shoot and seedling length followed by V₃ and V₁. As far as interaction between variety and integrated nutrient management; the maximum root, shoot and seedling length (32.50, 23.00 and 55.00) was obtained from treatment T₁₅ 25% RDF + FYM + Bio fertilizer (Azotobacter +PSB) + Early Wonder and the minimum root, shoot and seedling length (19.75, 11.25 and 31.00) remained from treatment T₁ Control + Sweety Control. Similar findings were reported by Anitha (2015) ^[4], Aishwath *et al.* (2011) ^[2], in maize. Increase in root length, shoot length and seedling length due to recommended doses of NPK may be due to improved quality of seed, nitrogen and mineral content in seed.

Improved root length, shoot length and seedling length by applying PSB + Azotobacter with FYM and 25% RDF also reported by Wagh (2002) in sweet corn.

Table 1: Effect of integrated nutrient management on germination per cent, root length, shoot length and seedling length.

Germination per cent										
Treatment	T ₀	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	Mean
V ₁	79.25	82.50	80.50	83.25	85.25	89.25	84.25	85.00	87.25	84.05
V ₂	82.75	85.75	83.75	86.25	87.62	92.62	88.50	89.50	90.50	87.47
V ₃	80.50	83.25	81.50	83.50	83.50	90.00	86.00	87.00	88.00	84.80
Mean	80.83	83.83	81.91	84.33	85.45	90.62	86.25	87.16	88.58	
	V	T	V×T							
C.D.	0.66	1.14	2.01							
SE(d)	0.33	0.57	0.99							
	S	S	S							
Root length (cm)										
V ₁	19.75	23.00	20.00	23.50	27.25	30.75	28.25	29.00	29.25	25.63
V ₂	24.00	26.00	24.50	27.00	28.25	32.50	29.25	28.50	28.25	27.58
V ₃	21.75	23.50	21.75	24.00	26.25	30.50	28.75	29.75	29.75	26.22
Mean	21.83	24.16	22.08	24.83	27.25	31.25	28.75	29.08	29.08	
	V	T	V×T							
C.D.	0.70	1.22	2.11							
SE(d)	0.35	0.61	1.06							
	S	S	S							
Shoot length (cm)										
V ₁	11.25	12.75	12.50	13.25	14.00	20.75	16.75	19.00	20.50	15.63
V ₂	13.75	15.50	14.50	15.50	18.00	23.00	19.50	21.25	23.00	18.22
V ₃	12.75	14.50	14.00	14.25	15.25	22.00	18.00	20.00	21.00	16.86
Mean	12.58	14.25	13.66	14.33	15.75	21.91	18.08	20.08	21.50	
	V	T	V×T							
C.D.	0.49	0.86	1.04							
SE(d)	0.24	0.43	0.74							
	S	S	S							
Seedling length (cm)										
V ₁	31.00	35.75	32.50	36.75	39.50	51.50	45.00	48.00	49.75	41.08
V ₂	37.75	41.50	39.25	42.50	46.50	55.00	48.75	49.75	51.25	45.80
V ₃	35.00	38.00	35.75	38.25	41.50	52.50	46.75	49.75	50.75	43.13
Mean	34.58	38.41	35.83	39.16	42.50	53.00	46.83	49.16	50.58	
	V	T	V×T							
C.D.	0.95	1.65	2.56							
SE(d)	0.47	0.83	1.43							
	S	S	S							

The data recorded for seedling fresh weight and seedling dry weight of seed in the laboratory showed significant differences among different treatments for seed germination. The maximum seedling fresh and dry weight (5.66g and 0.55g) was recorded in treatment T₅ followed by T₈, T₇, T₆, T₅, T₄, T₃, T₁, T₂ and minimum seedling fresh and dry weight (4.84g and 0.31g) was recorded in treatment T₀. Variety Early wonder recorded maximum seedling fresh and dry weight followed by V₃ and V₁. As far as interaction between variety and integrated nutrient management; the maximum seedling fresh and dry weight (6.35g and 0.65g) was obtained from treatment T₁₅ 25% RDF + FYM + Bio fertilizer (Azotobacter +PSB) + Early Wonder and the minimum seedling fresh and dry weight (3.95g and 0.33g) remained from treatment T₁ Control + Sweety. Similar findings were reported by Haile (2013), Channabasanagowda *et al.* (2008) in maize.

The data recorded for vigour index I and vigour index II of seed in the laboratory showed significant differences among different treatments for seed germination. The maximum

vigour index I and vigour index II (4805.91 and 50.82) was recorded in treatment T₅ followed by T₈, T₇, T₆, T₅, T₄, T₃, T₁, T₂ and minimum vigour index I and vigour index II (2799.25 and 25.81) was recorded in treatment T₀. Variety Early wonder recorded maximum vigour index I and vigour index II followed by V₃ and V₁. As far as interaction between variety and integrated nutrient management; the maximum vigour index I and vigour index II (5094.50 and 60.45) was obtained from treatment T₁₅ 25% RDF + FYM + Bio fertilizer (Azotobacter +PSB) + Early Wonder and the minimum vigour index I and vigour index II (2455.25 and 26.68) remained from treatment T₁ Control + Sweety. Similar findings were reported by Pathak (2014), Fadlalla *et al.* (2016) in maize. The seedling vigour index and fresh and dry weight of seedlings which really indicate the overall seed quality has varied significantly with the treatment and these values were significantly higher with application of PSB + Azotobacter with FYM and 25% RDF.

Table 2: Effect of integrated nutrient management on seedling fresh weight, seedling dry weight, vigour index I and vigour index II.

Seedling fresh weight (g)										
Treatment Varieties	T ₀	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	Mean
V ₁	3.95	4.45	5.06	4.63	4.86	4.83	5.58	6.10	5.26	4.97
V ₂	5.61	6.09	5.60	5.72	5.93	6.35	4.37	4.75	4.53	5.44
V ₃	4.96	5.59	5.63	4.19	4.68	5.82	4.54	5.05	5.15	5.06
Mean	4.84	5.38	5.43	4.85	5.16	5.66	4.83	5.30	4.98	
	V	T	V×T							
C.D.	0.28	0.49	0.85							
SE(d)	0.14	0.24	0.42							
	S	S	S							
Seedling dry weight (g)										
V ₁	0.33	0.36	0.37	0.38	0.44	0.46	0.46	0.48	0.53	0.42
V ₂	0.34	0.35	0.35	0.37	0.93	0.65	0.44	0.49	0.55	0.49
V ₃	0.27	0.35	0.36	0.37	0.42	0.56	0.43	0.45	0.52	0.41
Mean	0.31	0.35	0.36	0.37	0.59	0.55	0.44	0.47	0.53	
	V	T	V×T							
C.D.	0.56	0.17	0.88							
SE(d)	0.05	0.08	0.15							
	S	S	S							
Vigour index I										
V ₁	2,455.25	2,949.50	2,616.50	3,057.75	3,367.50	4,597.00	3,793.25	4,077.25	4,342.75	3,472.97
V ₂	3,124.25	3,559.25	3,286.50	3,664.75	4,074.00	5,094.50	4,314.50	4,454.50	4,640.25	4,023.61
V ₃	2,819.75	3,162.75	2,913.25	3,195.50	3,465.50	4,726.25	4,020.00	4,329.50	4,466.50	3,677.66
Mean	2,799.75	3,223.83	2,938.75	3,306.00	3,635.66	4,805.91	4,042.58	4,287.08	4,483.16	
	V	T	V×T							
C.D.	91.09	157.77	236.30							
SE(d)	45.66	79.09	137.00							
	S	S	S							
Vigour index II										
V ₁	26.68	29.82	30.56	31.79	37.67	41.04	38.91	41.00	46.40	35.98
V ₂	28.37	30.24	29.33	32.13	37.91	60.45	39.18	44.09	49.79	39.05
V ₃	22.37	29.46	29.86	31.08	35.14	50.98	37.32	39.93	46.10	35.80
Mean	25.81	29.84	29.91	31.67	36.90	50.82	38.47	41.67	47.43	
	V	T	V×T							
C.D.	8.33	7.30	7.15							
SE(d)	2.11	3.66	6.34							
	S	S	S							

Conclusion

It can be concluded from the findings of the present study that among the different varieties of maize, early wonder showed superior performance in term of seed quality. Among the treatments T₅ [25% RDF + FYM + Bio fertilizer (Azotobacter +PSB)] resulted the highest quality parameters of maize seed.

Combinations of varieties with treatment Early wonder with T₅ [25% RDF + FYM + Bio fertilizer (Azotobacter +PSB)] treatment had showed the best performance in seed quality characters (germination per cent, root length, shoot length, seedling fresh weight, seedling dry weight, vigour index I and Vigour index II).

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