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RESEARCH ARTICLE

Effect of site specific nutrient management on production and productivity of maize (*Zea mays* L.) under mid hill condition of Chhatisgarh

■ **A.K. SINHA**

SUMMARY

A field experiment was conducted in two consecutive *Kharif* seasons of 2012 and 2013 at Ambikapur to work out the effect of nutrient management on growth and development behavior of maize (*Zea mays* L.) hybrids. Plant height, leaf-area, dry matter accumulation, and crop growth rate (CGR) were significantly higher with site-specific nutrient management (SSNM) over the recommended dose of fertilizer (RDF) under conservation agriculture. On the maize hybrids, 'PMH 3' recorded significantly highest plant height, dry-matter accumulation and crop growth rate at various stages which was at par with 'PMH 1' but significantly superior to other hybrids. Significantly lowest leaf- area, dry matter accumulation and crop growth rate was recorded with 'HQPM 1'. SSNM recorded highest yield attributes, *viz.*, cob length (cm), cob girth (cm), grain rows/cob, grains/row, shelling per cent and 1000 grain weight (g) significantly higher over 50 per cent RDF but at par with 100 per cent RDF. SSNM recorded significantly highest cob yield and grain yield (kg/ha) over 100 and 50 per cent RDF. With regards to maize hybrids 'PMH 3' recorded yield attributes, *viz.*, cob length (cm), cob girth (cm), grain rows/cob, grains/row, shelling per cent and 1000 grain weight (g) which was at par with 'PMH 1' but significantly superior to other hybrids. Significantly lowest yield was recorded by 'HQPM 1'.

Key Words : Maize, Site specific nutrient management, Crop growth rate, Leaf area

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Maize crop regarded as a queen of cereals occupies pride place among rainy season (*Kharif*) crops in India and contributing around 24 per cent of total cereal production (Singh *et al*., 2011). It is cultivated in India over 8.67 million ha with 22.26 million tonnes production having an average productivity of 2566 kg/ha, contributing nearly 8 per cent in the national food basket (DACNET, 2014). Now-a-days, maize is gaining importance in conservation agriculture as it is a wide- spaced crop, having slow growth rate in its early stage, which leads to more loss of water, and nutrient through evaporation and heavy infestation of weeds. Productivity of maize is also limited by low fertilizer efficiency, inadequacy in existing fertilizer recommendation and ignorance of nutrient balance and hence, pausing serious threat in maize production. The nutrient Expert™ for hybrid maize is a new computer-

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based decision support tool developed to assist local experts to quickly formulate fertilizer guidelines for hybrid maize based on the principles of site-specific nutrient management (SSNM). There exists significant opportunity to increase fertilizer efficiency and productivity of maize by adopting nutrient expert-based field specific fertilizer recommendations (Satyanarayana *et al.,* 2013). Hence, present field investigation was carried out to evaluate five top maize hybrids under site specific nutrient management system and recommended dose of fertilizer (RDF).

MATERIAL AND METHODS

The present investigation was conducted during rainy (*Kharif*) seasons of 2012 and 2013 at the Research Farm, RMD Collage of Agriculture and Research Station, Ambikapur (Chhattisgarh) situated at $23^0$18' N latitude and $83^0$15' E longitude and at altitude of 611 meter above mean sea level. The soil of experimental field was sandy loam in texture. Chemical analysis of the soil (top 15 cm) showed an acidic pH (5.7), organic carbon 0.56 per cent, 234 kg/ha nitrogen, 8.4 kg/ha phosphorus, 268 kg/ha potassium. The meteorological data recorded at meteorological observatory of the station indicated that rainfall received during the crop seasons was 1120 mm (53 rainy days) and 1000.2 mm (50 rainy days) in 2012 and 2013, respectively. The crop experienced mean weekly maximum temperature ranged from 24.1 to 31.7 ^{0}C and 24.4 to 32.0 ^{0}C during 2012 and 2013, respectively whereas mean weekly minimum temperature ranged from 4.7 to 20.4 ^{0}C and 6.1 to 23.6 ^{0}C during 2012 and 2013, respectively. The field experiment was laid out in split block design with three treatments of fertility levels, 50 per cent RDF (75:30:20 kg N:P_2O_5:K_2O kg/ha), SSNM based fertilizer dose (170:67:86 kg N:P_2O_5:K_2O kg/ha) and 100 per cent RDF (150:60:40 kg N:P_2O_5:K_2O kg/ha) in main plots and four maize hybrids PMH 1, PMH 3, HQPM 1, CMH-08-350 and CMH-08-292 as sub plot treatments with three replications. The crop was sown in 1st week of July in both the years. Nitrogen as per treatment was applied in four splits. Twenty per cent dose of nitrogen along with full dose of phosphorus and potassium were applied at the time of sowing. The remaining dose of nitrogen was applied in four splits at 30 (30%), 45 (30%) and 60 (20%) days after sowing. Previous maize crop was turned down and mixed in soil for conservation agriculture. Maize hybrids were sown at spacing of 75 cm with plant to plant spacing of 20 cm to maintain the plant population of 66,666 plants/ha using 25 kg seeds/ ha. Gap filling and thinning were done within 10 days after sowing to maintain the optimum plant population. Weeds were controlled by pre-emergence application of atrazine (1.5 kg *a.i.*/ha) to control the initial weed flushes whereas latter weed flushes were controlled by mechanical weeder at 25 days after sowing. Five random plants were tagged randomly from each plot for recording of growth and yield attributes. Gross returns, net returns and benefit: cost ratios were calculated on the basis of prevailing market price of inputs and produce. All data obtained in the cropping sequence experiment for 2 consecutive year of study were statistically analysed using *F*- test, the procedure given by Gomez and Gomez (1984), critical difference (CD) values at P=0.05 were used to determine the significance of differences between means.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Growth characters :

Fertility level significantly affected the growth characters of maize hybrids. Significantly higher growth characters were recorded with SSNM over 100 and 50 per cent RDF (Table 1). It seems that SSNM- based balanced dose provided nutrient as per the crop requirement, hence, better plant height was observed with SSNM. The leaf area and dry matter accumulation have direct correlation with grain yield of crop as the leaf area indicates the photosynthetic efficiency while dry-matter accumulation shows the crop health. Leaf-area, dry matter accumulation and crop growth rate was significantly increased by SSNM followed by 100 per cent RDF and significantly lowest was recorded with 50 per cent RDF.

With regards to different maize hybrids at harvest significantly highest plant height was recorded by 'PMH 3'over all other hybrids and significantly lowest plant height was recorded by "HQPM 1" (Table 1). Of the different maize hybrids, 'PMH 3' recorded highest leaf-area, dry matter accumulation and crop growth rate which was at par with 'PMH 1' but significantly superior to other hybrids. Significantly lowest leaf- area, dry matter accumulation and crop growth rate was recorded with 'HQPM 1'.

It clearly showed that owing to higher leaf- area, dry matter accumulation and crop growth rate, SSNM proved better than other nutrient application. Similarly, Ashok (2013) also reported that 'PMH 3' recorded the highest dry matter accumulation/plant as compared to other hybrids at all growth stages of maize.

Yield attributes and yield of maize hybrids :

Fertility level significantly affected the yield attributes and yield of maize hybrids. All the yield attributes, *viz.*, cob length (cm), cob girth (cm), grain rows/cob, grains/row, shelling per cent and 1000 grain weight (g) were recorded significantly higher by SSNM over 50 per cent RDF but at par with 100 per cent RDF (Table 2). SSNM recorded significantly highest cob yield and grain yield (kg/ha) over 100 and 50 per cent RDF.

With regards to maize hybrids 'PMH 3' recorded yield attributes, *viz.*, cob length (cm), cob girth (cm), grain rows/cob, grains/row, shelling per cent and 1000 grain weight (g) which was at par with 'PMH 1' but significantly superior to other hybrids. Significantly lowest yield was recorded by 'HQPM 1'. Enhancement in growth attributes lead to photosynthate partitioning and better source-sink relationship, which enhances yield attributes. Kolo *et al*. (2012) also confirmed similar findings in maize.

Table 1: Effect of nutrient management practices and maize hybrids on growth characters and growth rate (pooled data of 2 years)

Treatments	Plant height (cm)	LAI at 90 DAS	Dry matter accumulation at 90DAS (g/plant)	CGR (g/day)		
				0-30 DAS	30-60 DAS	60-90 DAS
Sowing schedule (Main plot)						
50% of RDF	191.7	2.047	301.8	1.09	1.36	6.80
SSNM based fertilizer	273.4	2.178	354.8	1.2	1.52	8.17
100% RDF	261.4	2.118	328.8	1.15	1.42	7.60
S.E. ±	3.2	0.020	6.0	0.01	0.01	0.10
C.D. (P=0.05)	9.5	0.058	17.5	0.04	0.04	0.40
Fertility level (Sub plot)						
PMH 1	249.4	2.166	339.0	1.18	1.47	7.73
PMH 3	252.2	2.207	346.0	1.20	1.50	7.87
HQPM 1	221.0	2.007	308.0	1.08	1.35	7.08
CMH-08-350	242.6	2.067	321.0	1.13	1.41	7.40
CMH-08-292	245.7	2.127	327.0	1.15	1.43	7.53
S.E. ±	2.5	0.014	2.3	0.01	0.01	0.06
C.D. (P=0.05)	9.7	0.057	8.9	0.03	0.04	0.18

DAS, Days after sowing; CGR, Crop growth rate

Table 2 : Effect of nutrient management practices and maize hybrids on yield attributes and yield (pooled data of 2 years)

Treatments	Cob length (cm)	Cob girth (cm)	Grain rows/cob	Grain/ row	Cob yield (kg/ha)	Shelling (%)	1000-grain weight (g)	Grain yield (kg/ha)
Sowing schedule (Main plot)								
50% of RDF	15.6	14.0	12.1	29.4	4972.0	78.4	316.6	3995.7
SSNM based fertilizer	16.7	14.8	13.1	31.4	8236.0	82.6	339.5	6759.2
100% RDF	15.9	14.4	12.6	31.3	7151.6	80.7	326.2	5594.2
S.E ±	0.3	0.2	0.2	0.3	254.1	0.7	5.4	208.9
C.D. (P=0.05)	0.9	0.7	0.6	0.8	999.1	2.0	19.2	821.2
Fertility level (Sub plot)								
PMH 1	16.2	14.6	12.8	30.8	7787.3	78.2	330.8	6067.2
PMH 3	17.0	14.9	13.2	31.6	7900.0	81.7	336.8	6439.6
HQPM 1	15.4	14.0	12.2	30.2	5785.3	80.9	321.9	4669.3
CMH-08-350	15.6	14.2	12.4	30.2	6064.3	80.8	322.4	4885.2
CMH-08-292	16.1	14.2	12.4	30.6	6395.9	81.4	325.2	5187.3
S.E ±	0.2	0.2	0.2	0.2	257.6	0.5	2.92	198.7
C.D. (P=0.05)	0.7	0.6	0.5	0.6	750.4	1.8	8.53	579.0

Interaction :

The grain yield significantly influenced with interaction effect of fertility level and different maize hybrids (Fig. 1). Combined effect of SSNM and 'PMH 3' recorded significantly higher grain yield (8.0 t/ha) which was comparable to SSNM and 'PMH 1' (7.3 t/ha) but significantly superior than all other combinations. Significantly lowest yield was recorded with combination of 50 per cent RDF and 'HQPM 1' (3.4 t/ha). The higher grain yield with the corresponding treatment combinations could be attributed to the adequate supply of nutrients through balanced nutrient management system, proper growth and yield attributes. This led to higher grain yield.

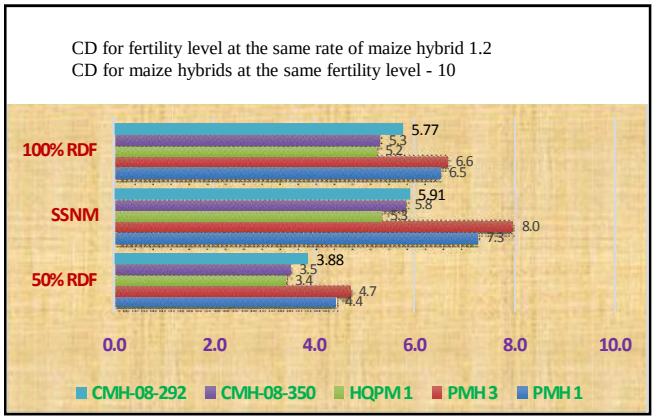

Fig. 1: Interaction effect of fertility level and maize hybrids on yield (t/ha)

It can be concluded from the results that all growth, yield attributes and grain yield in maize can be enhanced with SSNM-based nutrient management over recommended dose of fertilizer along with use of 'PMH 3'.

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