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Dry Matter Partitioning at Harvest and Yield of Maize (*Zea mays* L.) as Influenced by Integration of Various Nutrients

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A B S T R A C T

A field experiment was carried out in two successive years 2010 and 2011 during *Kharif* season to find out effect of various nutrient sources on dry matter partitioning at harvesting stage, and yields of maize (*Zea mays L.*). The results of present investigation revealed that maximum dry matter in leaves, stem, tassel and cob was accumulated under 100% NPK+FYM 10 t ha^{-1}. Integrated use of FYM 10 t ha^{-1} with 100% NPK resulted in the highest grain (3994 kg ha^{-1}) and stover (5836 kg ha^{-1}) yield of maize.

Introduction

Among all food crops cereals rice and wheat have been under the main focus of this revolutionary progress however, maize, the queen of cereals occupies a pride place among cereal crops in India. It is emerged out as third most important food crop after rice and wheat. Maize a predominant *Kharif* crop in Sub humid southern plain of Rajasthan because it is a stable food crop for tribal belt. Maize is a exhaustive feeder of nutrients and continuous cropping results in substantial amounts that often exceed replacement by manure or fertilizer, leading ultimately to deterioration in soil (Usadadiya and Patel, 2013). Amongst the growth inputs, mineral nutrients play a significant role not only in exploiting the realizable potential of the crop but also to maintain nutrient balance in soil for crop production.

Thus, emphasis on mineral nutrition is very essential. For higher crop yields there is a need for the application of higher dose of fertilizers.

But the increased use of high analysis fertilizers and adaptation of high yielding cultivars having high demand of secondary and micro nutrients for enhancing crop productivity has resulted in their deficiencies due to continued removal from soil (Tiwari, 2008).

The finite natural reserves of these nutrients in soil are shrinking and are declining at a fast rate in the absence of their replenishment. Thus balanced fertilization of crops is needed for sustaining higher level of production and maintaining proper nutrient balance in soil.

Materials and Methods

A field experiment was carried out under All-India coordinated Research Project on Long Term Fertilizer Experiment initiated in *Kharif* 1997 in two successive years during *kharif* 2010 and 2011 at instructional farm Rajasthan College of Agriculture, Udaipur to assess the effect of continuous application of plant nutrients through organic and inorganic sources and its combination on dry matter partitioning and yield of maize.

The experiment constituted in randomized block design with twelve treatments, *viz.*100%NPK(T_1),100%NPK+Zn(T_2), 100% NPK+Zn+S (T_3), 100%NPK+S (T_4),100%NPK+seed treatment with *Azotobacter* (T_5), FYM 10 t ha^{-1} + 100% NPK(-NPK of FYM) (T_6), 100% NPK + FYM 10 t ha^{-1} (T_7), FYM 20 t ha^{-1} (T_8), 150% NPK(T_9), 100% NP (T_{10}), 100% N (T_{11}) and absolute control (T_{12}) were replicated four times.

The sources used for applying N, P and K were urea, di-ammonium phosphate (adjusted for its N content) and muriate of potash, respectively.

Gypsum and zinc sulphate ($ZnSO_4.7H_2O$) were used to supply S and Zn. The other sources of nutrients were FYM (farm yard manure) and biofertilizer (*Azotobacter* sp.). The dose of the NPK for maize was worked out according to the soil test fertilizer recommendation.

The 100 % NPK dose in kg ha^{-1} worked out was 120: 60: 30 for maize crop. The doses for sulphur and zinc were framed as 40 kg S ha^{-1} and 5 kg Zn ha^{-1}, respectively while FYM was applied as per the treatments. Maize variety PEHM-2 was used as test crop with seed rate of 25 kg ha^{-1} at inter row of 60 cm and plant to plant spacing of 20 cm.

Results and Discussion

Dry matter partitioning

Maximum dry matter accumulation by leaves was recorded by integrated use of 100% NPK + FYM 10 t ha^{-1} in both the years, however, it was at par with 150%NPK.

Likewise stem dry matter production was highest in conjoint application of 100% NPK + FYM 10 t ha^{-1}. It was at placed on same bar with 150% NPK and 100% NPK with sulphur application in both the years. Dry weight of tassel and cob also was registered under 100% NPK + FYM 10 t ha^{-1}.

The significant effects of these parameters as a consequence of FYM in conjugation with chemical fertilization are attributed to the favorable nutritional status of soil resulting into increased biomass production of the crop.

This may also be attributed to favorable effect of FYM on microbial activity and root proliferation in soil which caused solubilizing effect on native phosphorus and other nutrients.

However, as fertilizer dose increased, the beneficial effects decreases because due to excessive use of fertilizers resulting in over exploitation of nutrients particularly micronutrients. The results of combined use of fertilizers and FYM are in close agreement with the findings of Singh *et al.*, (2009), Kumar and Dhar (2010) and Dilshad *et al.*, (2010) (Table 1).

Yield

The highest grain yield was recorded by application of 100% NPK + FYM 10 t ha^{-1} and its performance was at par with 150% NPK in both the years. Next superior treatment in this regards was 150% NPK (Table 2).

Table.1 Effect of integrated nutrient management on dry matter partitioning of maize

	Dry matter production (g) at harvest											
Treatments	**Leaves**			**Stem**			**Tassel**			**Cob**		
	2010	**2011**	**pooled**	**2010**	**2011**	**pooled**	**2010**	**2011**	**pooled**	**2010**	**2011**	**pooled**
100% NPK	11.32	11.17	11.24	27.02	26.86	26.94	5.43	5.23	5.33	119.12	118.42	118.77
100% NPK + Zn	11.44	11.30	11.37	27.45	27.30	27.37	5.36	5.16	5.26	119.82	119.13	119.47
100% NPK + S + Zn	11.35	11.20	11.27	27.92	27.78	27.85	5.47	5.27	5.37	126.67	126.05	126.36
100% NPK + S	11.96	11.83	11.89	27.52	27.37	27.44	5.35	5.14	5.24	120.85	120.17	120.51
100% NPK + *Azotobacter*	12.02	11.89	11.96	25.82	25.65	25.73	5.46	5.26	5.36	120.07	119.38	119.73
FYM 10 t ha^{-1} + 100% NPK (–NPK of FYM)	12.16	12.03	12.10	27.24	27.08	27.16	6.07	5.88	5.97	118.50	117.80	118.15
100% NPK + FYM 10 t ha^{-1}	12.43	12.30	12.37	32.39	32.29	32.34	6.42	6.23	6.33	131.67	131.10	131.39
FYM 20 t ha^{-1}	10.97	10.82	10.89	24.78	24.60	24.69	5.19	4.99	5.09	109.62	108.82	109.22
150 % NPK	12.32	12.19	12.25	30.72	30.60	30.66	5.61	5.42	5.51	125.68	125.05	125.36
100% NP	11.98	11.84	11.91	25.62	25.45	25.53	5.37	5.17	5.27	107.96	107.15	107.56
100 % N	10.36	10.21	10.29	24.55	24.37	24.46	5.25	5.05	5.15	103.28	102.43	102.85
Control	7.21	7.03	7.12	15.69	15.42	15.56	4.57	4.36	4.46	79.78	78.69	79.24
S.Em. ±	0.43	0.44	0.31	0.63	0.63	0.44	0.24	0.25	0.17	2.18	2.20	1.55
C.D. (P = 0.05)	1.25	1.26	0.87	1.80	1.82	1.26	0.70	0.71	0.49	6.27	6.33	4.37

Table.2 Effect of integrated nutrient management on grain and Stover yield of maize

Yield (kg ha^{-1})						
	Grain			**Stover**		
Treatments	**2010**	**2011**	**pooled**	**2010**	**2011**	**pooled**
100% NPK	3408	3194	3301	5218	4749	4984
100% NPK + Zn	3595	3290	3442	5507	4871	5189
100% NPK + S + Zn	3690	3487	3589	5556	5187	5371
100% NPK + S	3460	3274	3367	5324	4845	5085
100% NPK + *Azotobacter*	3508	3377	3442	5342	4991	5167
FYM 10 t ha^{-1} + 100% NPK (–NPK of FYM)	3469	3440	3454	5322	5201	5261
100% NPK + FYM 10 t ha^{-1}	4075	3912	3994	6055	5618	5836
FYM 20 t ha^{-1}	2360	2364	2362	3540	3487	3514
150 % NPK	3777	3698	3737	5567	5585	5576
100% NP	2950	2779	2865	4556	4197	4376
100 % N	2337	2137	2237	3687	3274	3480
Control	1438	1285	1362	2241	1940	2091
S.Em. ±	103	106	74	165	184	124
C.D. (P = 0.05)	297	304	208	475	529	349

The treatment receiving 100% NPK and its combination with Zn, Zn+S, *Azotobacter* seed treatment and FYM 10 t ha^{-1} + 100% NPK (-NPK of FYM) showed statistically equivalent results in raising grain yield on pooled basis. The application of 100% NPK with FYM 10 t ha^{-1} produced highest Stover yield (5836 kg ha^{-1}) on pooled basis and the result of which was statistically at par to 150% NPK. Results showed that integration of 100 % NPK with FYM 10 t ha^{-1} brought about significant improvement in yield over unfertilized control and 100% NPK. This indicated a favourable soil micro climate régime induced by the incorporation of FYM. Application of FYM reduces P fixation by releasing considerable aborints and variety of organic acids during deposition and as well as inducing chelating effects on micronutrients which probably enhanced the availability of phosphorus (Behera and Singh (2009). Applications of FYM not only solubilize the availability of micronutrients but also contains significant amount of N, P and K. Thus application of FYM has resulted in an overall significant increase in uptake of nutrients at lesser cost but longer in durability or duration. These are in confirmation with findings of Behera and Singh, (2009) and Das *et al.,* (2010).

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