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GRAIN YIELD AND QUALITY PARAMETERS OF MAIZE (*ZEA MAYS* L.) AS INFLUENCED BY MANURING AND FERTILISATION IN FINGER MILLET – MAIZE CROP SEQUENCE OF *ALFISOLS* OF KARNATAKA

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ABSTRACT
Crop sequences represent a system approach in crop production research enabling the available natural resources to be preserved and more efficiently utilized. Field experiments conducted at the Zonal Agricultural Research Station, Gandhi Krishi Vigyan Kendra, University of Agricultural Sciences, Bangalore involved growing of finger millet during Kharif and maize in *Rabi* during the seasons of 1999 -2000 and 2000 –2001 indicated the influence of intensive manuring programme on grain yield and quality attributes of maize grain. Grain yield of maize was significantly higher in 100 % NPK + FYM (to first crop) + lime treatment which was on par with the application of 100 % NPK + FYM (2315 kg / ha) and 150 % recommended dose of NPK (2225 kg /ha). Significant differences were observed for sugars, crude protein, starch, total carbohydrates and phenol content of maize grain. The study indicated the apparent effect of FYM treatment possessing an overriding beneficial effect in producing higher grain yield as well maize grain of better quality.

KEY WORDS*:* Fertilization, Intensive manuring, Maize grain quality, Crop sequence.

INTRODUCTION
The grain quality in different crops is assuming significance from productivity considerations. The grain quality is an integral effect of the nutritional, physiological and biochemical factors (Srivastava and Mehrotra, 1991). As a general rule, the amount of starch/ protein/ carbohydrates/ sugars accumulating in the grain is a genetic parameter. Little information is available regarding the biochemical changes in Maize due to fertilization. The knowledge on quality constituents of maize grain as influenced by Long term application of fertilizers gains importance. An attempt was, therefore, made to investigate the amounts of qualitative elements such as sugars, starch, crude protein, phenols that are accumulated in the grain as influenced by the differential level and sources of nutrients as well as urease, phosphatase and dehydrogenase enzyme activity.

MATERIALS & METHODS
Field experiments were conducted at the Zonal Agricultural Research Station, Gandhi Krishi Vigyan Kendra, University of Agricultural Sciences, Bangalore during *Kharif* (finger millet) and *Rabi* seasons of 1999 - 2000 and 2000–2001. The experiment consisted of eleven treatments involving organics, inorganic and amendments and it was laid out in Randomized Complete Block design with four replications. The gross plot size was 16 mt x 9 mt and finger millet was sown during Kharif followed by Maize during rabi in cropping sequence. Recommended cultural operations implemented for both crops. Recommended fertilizer dose adopted for fingermillet was 100:50:50kg NPK /ha and for maize 150:75:40kg NPK/ha. Urea was used as a source of nitrogenous fertilizer, Single Super Phosphate (except T9) and DAP (only T9) as a source of P fertilizer and muriate of potash as potassium source. For treatments that included FYM it was supplied to respective plots at 10 tons /ha to first crop (fingermillet) in fingermillet – maize crop sequence. The same thing holds good in case of treatments which included lime and lime was incorporated much before application of FYM and it was applied based on lime requiirement. The necessary growths as well as yield observations were collected at different growth stages and harvest. Nutritive qualities of maize grains were analyzed by adopting standard procedures. The data was analyzed for individual years as well as pooled analysis for both the years and results are discussed based on the pooled data only. Fischer's method of analysis of variance was applied for the analysis and interpretation of the data as given by Panse and Sukhatme (1967).

RESULTS & DISCUSSION
Grain Yield
Grain yield of maize (table 1) was significantly influenced by intensive manuring programme. Application of 100 % NPK + FYM (to first crop) + lime recorded significantly highest grain yield (2580 kg /ha) and was on par with the application of 100 % NPK + FYM (2315 kg / ha) and 150 % recommended dose of NPK (2225 kg /ha) and these were significantly superior to rest of the treatment combinations. The higher yield with these treatments is attributed to residual effect of organic manure *i.e.*, Farm Yard Manure (FYM) applied to preceding crop of finger millet. Application of FYM to finger millet was adequate for increasing maize crop yield due to positive residual effect on maize crop which was not found from inorganic

fertilizers. This is in consonance with the findings of Sherchan and Gurung (1996). Further, significant build up of organic carbon and available phosphorus due to residual effect of FYM has been well documented (Suri and Puri, 1991; Singh *et al*., 1996; Jana and Ghosh, 1996). Also application of lime along with FYM brings about favourable effects on nutrient availability (Idota *et al*., 2000). The higher grain yield of maize may also be traced back to higher test weight (26.75g). This is further explained by significantly higher positive correlation between grain yield of maize and test weight (0.96*), girth and length of cob (0.96* and 0.92*) (Table 2). The multiple linear regression analysis involving weight of cob, length of cob, girth of cob, number of grains per cob and test weight explained the variation in maize grain yield to an extent of 96.00 % (R2 = 0.989). Straw yield also followed the same trend as that of grain yield.

TABLE 1: Test weight (g), grain yield (kg / ha) and straw yield (kg /ha) of maize as influenced by integrated nutrient supply and Management

Treatments	Test weight (g)			Grain yield (kg /ha)		
	1999 -2000	2000 -2001	Pooled	1999-2000	2000-2001	Pooled
T1: 50% Recommended NPK	21.99	22.82	22.40	1128	898	1013
T2: 100% Recommended NPK	22.74	23.57	23.15	1962	1797	1887
T3: 150% Recommended NPK	24.84	24.67	24.75	2223	2227	2225
T4:Recommended NPK+ Hand weeding	22.79	23.62	23.20	2013	1812	1975
T5: 100% NPK + Lime	23.15	23.98	23.31	2153	2213	2113
T6: 100% NP	17.25	18.08	17.66	456	336	397
T7: 100% N	16.92	17.82	17.40	337	163	250
T8: 100% NPK + FYM	25.51	25.34	25.42	2260	2370	2315
T9: 100% NPK (S free)	21.66	22.49	22.07	1755	1272	1399
T10: 100% NPK + FYM + Lime	27.84	25.66	26.75	2643	2516	2580
T11: Control	15.88	16.71	16.29	194	94	144
S.Em+	2.720	2.720	3.707	168.8	42.68	58.62
CD @5%	7.856	7.856	10.70	487.41	123.26	169.31

TABLE 2: Correlation matrix for grain yield of maize v/s yield components, nutrient status and growth components in maize as influenced by integrated nutrient supply and management

variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1) Grain Yield	1.00	0.96	0.96	0.92	0.94	0.97	0.84	0.92	0.97	0.90	0.91
2) Test weight		1.00	0.99	0.95	0.98	0.98	0.70	0.68	0.97	0.94	0.94
3) Girth of cob			1.00	0.98	0.99	0.99	0.64	0.64	0.98	0.95	0.97
4) Length of cob				1.00	0.98	0.98	0.51	0.55	0.95	0.95	0.99
5) Weight of cob					1.00	0.99	0.63	0.64	0.96	0.97	0.98
6) Number of grains per cob						1.00	0.59	0.63	0.98	0.94	0.97
7) Available N							1.00	0.69	0.63	0.60	0.50
8) Available P_2O_5								1.00	0.65	0.72	0.55
9) Available K_2O									1.00	0.90	0.95
10) Leaf area										1.00	0.94
11) Total Dry Matter (TDM)											1.00

Grain Qualitative Parameters

Significant differences were observed for sugars, crude protein, starch, total carbohydrates and phenol content of maize grain (Table 2). 100 % NPK + FYM treatment (T8) resulted in high content of reducing sugars (1.02%) in the grains. Increased rates of NPK promoted the % of reducing sugars from 0.56 to 0.90 which in turn was reflected on the better grain quality. The crude protein content varied marginally from 9.21 to 11.17 %, yet these minor differences proved statistically significant implying the influence of treatment differences on this quality parameter. The starch content had a tendency to decrease at high NPK levels. Combination of FYM with NPK (T8) showed the highest percent of starch (57.25) and the least content of starch was exhibited in control (47.00). Reduced corn starch due to N manuring as noticed here was also reported by Berzsenyi *et al.,* (1939). FYM treated plots tended to favour higher accumulation of total carbohydrates. From the biochemical activities, the phenol production is a specific attribute closely linked to disease resistance. It is interesting to note that FYM treatment (T8) could ensure a higher accumulation of phenol (0.17%) in tune with what was observed for protein, starch *etc*. It has become apparent that the FYM treatment possesses an overriding beneficial effect in producing maize grain of better quality. The absence / addition of any fertilizer, elimination S and K tended to decrease the grain quality marginally yet significantly.

TABLE 3: Quality parameters of maize as influenced by integrated nutrient supply and management

Treatment	Reducing Sugars (%)	Non-reducing sugars (%)	Total Sugars	Crude protein	Starch (%)	Total carbohydrates	Phenols
T1: 50% Recommended NPK	0.56	0.51	1.07	9.31	53.50	60.00	0.12
T2: 100% Recommended NPK	0.70	0.47	1.17	10.23	51.50	57.75	0.13
T3: 150% Recommended NPK	0.81	0.40	1.21	10.69	49.00	56.25	0.14
T4:Recommended NPK+ Hand weeding	0.90	0.25	1.15	10.33	52.30	59.50	0.13
T5: 100% NPK + Lime	0.75	0.39	1.14	10.21	53.20	60.25	0.11
T6: 100% NP	0.83	0.26	1.09	10.61	49.60	56.75	0.09
T7: 100% N	0.84	0.33	1.17	10.92	51.39	58.00	0.11
T8: 100% NPK + FYM	1.02	0.21	1.23	11.17	57.25	63.75	0.17
T9: 100% NPK (S free)	0.68	0.55	1.23	9.92	51.00	58.50	0.14
T10: 100% NPK + FYM + Lime	0.88	0.20	1.08	9.43	50.21	57.25	0.10
T11: Control	0.53	0.45	1.08	9.21	57.00	54.00	0.06
S.Em+	0.01	0.03	0.03	0.33	1.23	1.39	0.01
CD @5%	0.05	0.10	0.09	0.97	3.60	4.07	0.02

CONCLUSION

Grain yield of maize was benefitted more due to application of lime to previous crop in finger millet – maize crop sequence and also application of NPK + FYM improved the quality of maize grain by enhancing the sugar, starch and crude protein contents.

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