

THE MADRAS AGRICULTURAL JOURNAL

[PUBLISHED BY "THE MADRAS AGRICULTURAL STUDENTS' UNION" (M.A.S.U.)]

(Established 1911)

COIMBATORE - 3, INDIA

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Vol. 58

July 1971

No. 7

Quality of Summer Maize (*Zea mays*. L.) in Relation to Nitrogen Levels, Plant Population and Irrigation Regimes*

by

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Introduction: Due to increasing irrigation facilities and shortage of food grains, cultivation of maize (*Zea mays* L.) in summer season is gaining popularity in the vicinity of Agra. The quality of produce, specially protein and starch content is very important from diet and industrial point of view. The knowledge of their production per unit area is also necessary. The information on this aspect is very much lacking as no systematic work has been done specially in summer season. N application increases the protein content of grain and stover but efficient utilization of applied N can be obtained only with suitable plant population and optimum soil moisture favourable for crop growth. Keeping these points in view, the present study was undertaken to study the quality in relation to N levels, plant population and irrigation regimes.

Experiment: An experiment comprising three levels of N (60, 120 & 180 kg N/ha), three plant population (55,000, 65,000 and 75,000 plants/ha) and three irrigation regimes (applied at 40, 60 and 80% ASM) was laid out in 3³

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confounded design at B.R. College Agricultural Research Station, Bichpuri, Agra, during summer season. In all, 27 treatment combinations were replicated twice in 6 blocks of 9 plots each. Ganga safed-2 variety of Hybrid maize was sown in March in rows 75 cm apart at proper distance to maintain the required plant population. The crop was grown in sandy loam soil which was deficient in N (0.053%), medium in P_2O_5 (0.086%) and rich in potash (1.137%). In all, 4, 6 and 8 irrigations were applied in 40, 60 and 80% ASM respectively. Depth of each irrigation was according to moisture deficit in the soil obtained by gravimetric method, upto 90 cm depth.

Results and Discussions: The data pertaining to test weight, protein content and production, starch content and its production are presented in Table I.

TABLE I. Test weight, percent protein and starch content and their production as affected by N levels, plant population and Irrigation regimes

Treatment	500 grain weight (g)	Percent protein content		Production of protein (kg/ha)			Percent starch content in grain	Production of starch (kg/ha)
		grain	stover	grain	stover	total		
60 kg N/ha (N_1)	95.05	10.25	2.13	142.37	148.05	290.42	70.9	984.0
120 ,, (N_2)	97.00	11.00	2.48	163.45	173.43	336.88	70.4	1046.1
180 ,, (N_3)	103.43	11.86	2.58	172.52	190.66	363.18	64.4	938.3
S. E. \pm	2.37	0.41	0.09	6.35	8.86	—	—	—
C.D. at 5%	6.84	1.17	0.25	18.33	25.45	—	—	—
55,000 plants/ha (P_1)	99.97	11.16	2.55	145.35	164.23	309.58	69.0	898.4
65,000 ,, ha (P_2)	100.44	11.06	2.40	162.85	173.74	336.59	68.6	1001.7
75,000 ,, ha (P_3)	95.07	10.90	2.24	170.11	174.17	344.28	68.1	1068.3
S. E. \pm	2.37	0.41	0.09	6.35	8.86	—	—	—
C.D. at 5%	N.S.	N.S.	0.25	18.33	N.S.	—	—	—
Irrigation at								
40% ASM (I_1)	86.99	11.66	2.59	113.83	138.35	252.18	66.9	650.9
,, 60% ASM (I_2)	101.94	11.01	2.40	167.55	162.81	330.36	69.2	1044.5
,, 80% ASM (I_3)	106.55	10.44	2.20	196.93	211.06	407.99	69.5	1273.0
S. E. \pm	2.37	0.41	0.09	6.35	8.86	—	—	—
C. D. at 5%	6.84	1.17	0.25	18.33	25.45	—	—	—

The test weight and protein content of grain and stover were increased due to application of N and differences between 180 kg N/ha and 60 kg N/ha were found significant. This may be due to more absorption of N by the plants at adequate N level which ultimately resulted in higher protein content. Similar to this, Zuber *et al.* (1954), Galves *et al.* (1958) and Pantamkar *et al.* (1965) have

also reported increased protein content due to N application. Starch content decreased with N application and sudden fall was noted due to 180 kg N/ha over 120 kg N/ha. Here it may be pointed out that under low levels of N, accumulation of carbo-hydrates was more resulting in more starch and low protein content. The production of protein either through grain or stover was maximum at 180 kg N/ha whereas starch production was highest with application of 120 kg N/ha.

Increasing plant population has shown slight but non-significant reduction in test weight, protein content of grain or stover and starch content. However the production of protein and starch per ha was maximum with highest plant population. Under dense population probably competition for nutrients and light was more due to which slight reduction in protein and starch content was noted but the utilization of available nutrient and light per unit area was more efficient resulting in more production of these constituents.

The effect of irrigation is more interesting from quality point of view. Both grain and stover obtained under drier condition were superior in protein content but test weight and starch content were in favour of frequent irrigation. Probably under the scarcity of moisture, photo-synthetic activities were less due to less vegetative growth which resulted in smaller grains with low starch content and accumulation of N in the form of protein was more while under the plots, receiving irrigation at low soil moisture tension it was reduced due to dilution effect as growth and photosynthesis were more which gave higher yield. As the production of these constituents is the reflection of percent content and yield, it was highest with irrigation applied at 80% ASM followed by 60% ASM and 40% ASM respectively and the differences between two corresponding levels were found significant.

The effect of interaction of N levels \times irrigation has shown significant effect on percent protein content of grain (Table 2).

TABLE 2. Protein content in grain as affected by N levels \times irrigation regimes

	I ₁	I ₂	I ₃
N ₁	10.23	10.30	9.82
N ₂	11.51	11.33	10.16
N ₃	13.75	12.40	11.34
S.E.±	0.64		
C.D. at 5%	2.02		

The application of 180 kg N/ha under irrigation applied at 40% ASM resulted in significantly higher protein content over that of 60 kg N or 180 kg N/ha with irrigation applied at 80% ASM. Under frequently irrigated plots, carbohydrate production was more which resulted in grains with low protein content.

Protein production and per cent content in stover was influenced significantly with N levels under different plant population (Table 3).

TABLE 3. *Percent and production of protein through stover as affected by N levels × Plant Population*

Percent protein content			Production of protein (kg/ha)		
P ₁	P ₂	P ₃	P ₁	P ₂	P ₃
N ₁ 2.28	2.19	1.93	147.4	155.3	144.1
N ₂ 2.54	2.48	2.26	165.3	169.1	174.1
N ₃ 2.86	2.64	2.25	174.1	187.0	198.1
S.Em =	0.16			11.9	
C.D. at 5%	0.47			34.0	

Highest protein content was observed with highest N level and lowest plant population while protein production was maximum with 180 kg N/ha and highest plant population which was found significantly better over that of 60 kg N/ha under same plant population. This indicates that utilization of applied N was better under thick population.

Summary and Conclusion: An experiment conducted at Bichpuri, Agra to study the effect of levels of N and plant population under different irrigation regimes on quality of maize and production of different constituents showed that (1) With increasing N levels, test weight protein content in grain and stover increased but starch content was reduced considerably. Similar trend was noted with production of different constituents; (2) Different plant population could not show any significant effect either on quality or on production, however, decreasing protein content but increased production was noted with thick population; and (3) More protein content was observed in drier regime but test weight and starch content were in favour of frequent irrigation. The production of different constituents were improved with increasing number of irrigation.

Acknowledgement: Author is grateful to Dr. S. P. Sing, Asst. Professor of Agronomy, B. R. College, Bichpuri, Agra for his valuable guidance, and to Dr. R. R. Singh, Head of Agronomy Department, B. R. College Bichpuri, Agra for providing facilities.

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