

Influence of Nitrogen on the Root Growth of Maize Grown in Association with Different Legumes Under Rainfed Conditions*

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An experiment was conducted to study the influence of different nitrogen levels on root growth of maize grown pure and in association with different legumes under rainfed conditions. Raising *mung* and *Urad* with maize increased the volume and dry weight of maize roots. Application of nitrogen increased root growth of maize significantly when it was grown pure or in association with legumes. However, no beneficial effect of nitrogen was noticed when maize was grown with *urad*.

The root growth in maize is highly associated with fertilizer applications and their relationship becomes essential in order to counteract the competitive effect of legumes on root growth of maize. Nelson (1950) pointed out that nitrogen fertilization of maize leads to profuse proliferation of roots both in depth and extent. However, work carried out on root growth of maize in relation to different rates of nitrogen, when it is grown in association with different legumes under rainfed condition is meagre.

In view of this, observations were made and data were collected on the root growth (volume and dry weight) at different stages of maize crop grown in association with different legumes, in relation to nitrogen application under rainfed conditions.

MATERIALS AND METHODS

The experiment was conducted in a randomised block design, with fact-

orial concept, replicated four times, at the Research Farm, Meerut University, Meerut during *Kharif* 1973 and 1974. The surface soil (0-25 cm.) was sandy clay loam in texture, neutral having 0.046 per cent total nitrogen and 0.50 per cent organic carbon. In the first year (1973), the total rainfall was 607 mm, which was well distributed throughout the crop period while in second year the total amount of rainfall was 708 mm, out of which 660 mm. (94.6 per cent) was from 1st week of July to 15th of August and remaining period was dry.

The treatment, consisted of the combination of six crop mixtures (C₁-maize pure, C₂-maize + *mung*, C₃-maize + groundnut, C₄-maize + soybean, C₅-maize + *Urad* and C₆-maize + Cowpea) and three levels of nitrogen (40, 80 and 120 kg N/ha). The varieties used in the experiment were Ganga safed-2, T-44, T-46, Clark-63, T-9 and pusha Phagun for maize, *mung*, groundnut, soybean,

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Urad and cowpea respectively. Half of nitrogen (urea), 80 kg P_2O_5 (as single superphosphate) and 40 kg K_2O /ha (as murate of potash) were applied at the time of planting. The remaining half of nitrogen as urea was side dressed at knee high stage with maize rows only. A spacing of 75 x 25 cm. was adopted. The legume crops were sown in between two rows of normally planted maize. The net plot size was 4.5 x 3.5 meter. In each plot there were eight rows, each four meter in length.

Samples were collected from each plot at 3 stages viz., knee high (30-35 days after sowing) silking (70-75 days after sowing) and at maturity stage (100-105 days after sowing). The root samples were taken out with the help of *Khurpi*. For this purpose on the basis of available literature and as per procedure used by Mengal and Barber (1974), an area of 20, 35 and 45 cm. around each plant upto the depth of 30, 50 and 70 cm. was excavated to extract root system as thoroughly as possible at knee high, silking and maturity stage respectively. Only three samples were taken from each plot for observations. After removing root from stem portion, it was washed in running water through 20 mesh sieves. After washing, water was removed from roots with the help of blotting paper. The volume of root was recorded on the basis of water displacement (Archimedes principle). After measuring, the roots were dried in the sun for 24 hours, then dried in oven for 24 hours at 70° C and weighed.

RESULTS AND DISCUSSION

Effect of legumes association: It is seen that the volume and dry weight of maize roots on the whole was smaller at knee high stage and increased markedly at silking and at maturity stage in both the years (Table I). Effect of legume association on volume of roots was found to be significant at silking stage during 1974 only. At this stage, maize grown with *mung* and *urad* proved significantly superior to maize alone. Thus, growing of *mung* and *urad* with maize helped in greater ramification of root system in maize.

Effect of legume association on dry weight of roots was found to be significant at knee high stage during both the years and at silking stage during 1974 only. At knee high stage during 1973, significantly higher maize root weight was recorded with legume association over maize alone. However, during 1974 maize + groundnut and maize + *urad* produced significantly higher root yield over maize + cowpea, but it was on par with maize + *mung* and maize + soybean. At silking stage during 1974, maize + *mung*. This may be due to the fact that in the first year (well distributed rainfall), the associated legumes had more favourable effect than second year (ill distributed rainfall). In second year, growing of groundnut and *urad* with maize only was found to be better compared to pure crop of maize. It is interesting to note that growing of maize more favourably than other legumes. It may probably be attributed to early nodulation in *mung* and *urad* and release of nitrogen for the development of maize root.

TABLE I. Volume and dry Weight of maize roots plant as influenced by mixed cropping and nitrogen levels at different stages of growth

Treatment	Volume of roots (cm) ³												Dry weight of roots (gm)					
	Knee height stage			Silking stage			Maturity stage			Knee high			Silking stage			Maturity stage		
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
C ₁ Maize pure	10.50	6.40	32.63	21.10	53.54	23.33	1.52	0.74	7.39	6.05	14.12	7.04						
C ₁ Maize + mung	12.21	6.69	31.31	27.79	55.54	26.44	2.11	0.85	7.06	6.34	13.15	7.25						
C ₃ Maize + groundnut	10.08	7.42	31.96	25.42	53.08	23.75	1.76	0.93	7.46	7.26	12.40	7.54						
C ₄ Maize + Soybean	12.27	6.75	28.54	21.58	50.96	27.25	1.96	0.89	6.65	7.36	13.32	7.68						
C ₅ Maize + Urad	22.67	7.67	33.48	31.98	47.63	25.27	2.08	0.97	8.13	6.45	12.37	7.52						
C ₆ Maize + Cowpea	10.75	6.46	32.40	24.46	48.96	20.79	1.77	0.76	7.01	6.56	12.17	6.37						
CD at 5%	NS	NS	NS	6.11	NS	NS	0.12	0.15	NS	0.95	NS	NS						
N ₁ 40 Kg N/ha	10.27	6.24	27.11	19.64	37.58	19.61	1.69	0.77	6.16	5.92	10.13	6.36						
N ₃ 80 Kg N/ha	22.63	7.32	33.02	25.86	56.40	23.93	1.94	0.91	7.86	6.76	13.94	7.71						
N ₂ 120 Kg N/ha	22.83	7.13	35.01	25.66	60.88	27.89	1.96	0.89	7.84	6.84	14.70	7.63						
CD at 5%	NS	0.79	5.24	4.32	7.46	4.10	NS	0.11	1.53	0.67	2.02	0.86						

NS = Not significant

TABLE II. Effect of interaction of mixed cropping X Nitrogen levels on dry weight of roots (gm) of maize at maturity during 1973

Nitrogen levels	Crop mixtures					
	Maize pure	Maize mung	Maize Groundnut	Maize Soybean	Maize Urad	Maize cow pea
1	2	3	4	5	6	7
N ₁ - 40 Kg N/ha	12.91	11.50	14.50	15.16	15.16	11.17
N ₂ - 80 Kg N/ha	22.58	19.00	13.16	16.50	17.83	19.16
N ₃ - 120 Kg N/ha	21.00	22.00	18.50	21.66	16.50	17.86

CD at 5% - 4.72

Effect of Nitrogen: The effect of two higher levels of nitrogen viz. N₂, N₃ on volume and dry weight of maize root was significantly greater compared to lower level of nitrogen (N₁) at silking and maturity in both the years. The increase in percentage of dry weight of maize root with the application of 80 kg N/ha. over 40 kg N/ha. was 15.4, 27.5 and 37.5 at knee high, silking and maturity in 1973, while it was 18.2, 14.2 and 21.2 per cent respectively in 1974. However, per cent increase with the application of 120 kg N/ha. over 40 kg N/ha was 15.6, 27.2 and 45.0 at knee high, silking and maturity in 1973, while it was 15.5, 15.5 and 19.9 per cent respectively in 1974.

Effect of Legumes association with Nitrogen: It is seen from Table II that maize alone maize + *mung* and maize + cowpea with 80 and 120 kg N/ha produced significantly higher root yield of maize compared to 40 kg N/ha with non significant differences among themselves. However, maize + groundnut and maize + soybean at the highest level (120 kg N/ha) increased the root weight significantly compared to 40 and 80 kg N/ha with non-significant differences among the latter

two. This may be due to the heavy demand of nitrogen by associated legumes (groundnut and soybean) compared to other legumes. No interaction between nitrogen levels and maize + *urad* treatment was observed.

It is further noted from Table II that application of nitrogen at the rate of 40 kg N/ha did not influence significantly the root weight of maize when grown alone or in association with other legumes included in the experiment. However, application of 80 kg N/ha significantly increased the root weight of maize when grown alone compared to legumes association. At the highest level of nitrogen (120 kg N/ha), the root weight of maize when grown alone or with *mung* or with soybean did not differ among-themselves but they had significantly greater root weight compared to maize + *urad*.

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