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Studies on the Methods of Nitrogen Application and Presoaking Seed in Rainfed Sorghum (CO 20)

By

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ABSTRACT

Nitrogen application either through soil or foliage and combination of both recorded the same grain yield. Soil application of N in the form of farm yard manure or urea has the same effect. No differential response was seen for the number of splits in foliar application of urea on equal total nitrogen i. e. 22.5 kg N/ha. Pre-soaking seed in 10 per cent KH_2PO_4 solution influenced plant growth, uptake of nutrients, 500 grain weight and grain yield. 500 ppm gibberellic acid influenced germination rate and early growth.

INTRODUCTION

Some reports indicate that foliar application of fertilizer is as good as or better than soil application of comparable amount of N. (Fisher 1952). Further, foliar application act as a useful means of stimulating growth in very dry seasons when N added to the soil cannot be properly utilized. Among various methods of nutrient application the method which deposits the nutrients on the seed coat or inside the seed by absorption from solution is found useful. Hence with the object of finding out the effect of methods of application of N and pre-soaking seed with KH_2PO_4 rainfed sorghum, a trial was taken up at the Millet Breeding Station of Agricultural College, Coimbatore during the year 1969-70.

MATERIALS AND METHODS

An experiment was laid out in split plot design with three replications. under dry conditions. The soil was black clay with low available N and P and medium in K. Sorghum (CO 20) seeds were sown on 3-8-69 with a spacing of 45.7 x 15.2 cm. One seedling per hill was allowed to stand. Due to failure of rain one protective irrigation was given on 50th day to save the crop and the total quantity of rain received during the crop growth period was 348.5 mm. Main plot treatments consisted of pre-soaking seed viz. (1) unsoaked control (S_0) (2) presoaking in water (S_1) (3) 10 ppm KH_2PO_4 (S_2) and (4) 500 ppm gibberellic acid (S_3).

The seeds were soaked for 12 hours in the solution keeping a ratio of seeds to solution at 3 : 1 to avoid the risk of the constituent being leached away by an excess solution (Mehrotra *et al.* 1967). Then the seeds were washed with distilled water to remove traces of solution remaining on the seed surface and spread out for air drying. Untreated seeds were used for control plots.

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Methods of application of nitrogen (22.5 kg N/ha) formed the subplot treatments namely control (N_0), soil application of urea (N_1), farm yard manure (N_2), $\frac{1}{2}$ soil + $\frac{1}{2}$ foliar in two splits on 45th and 75th days after sowing (N_3), foliar in 2 splits on 30th and 60th days after sowing (N_4) and foliar on 30th, 45th and 75th days after sowing (N_5). Nitrogen was applied in the form of urea to all plots except N_2 and N_0. Urea and farm yard manure were applied at equal total nitrogen i. e. 22.5 kg. N / ha. Farm yard manure was incorporated in the soil before sowing. Soil application of urea was done at the time of sowing. 2.8 per cent urea solution with 1.0 per cent teapol by volume, was sprayed at the rate of 448 litre per ha for N_3 and N_5 plots and and 1000 litres per ha for N_4 plots, Sprayings were done with a hand compression sprayer in the morning between 8 and 10 A. M. Some quantity of water was sprayed in the rest of the plots at the time of each spraying. Basal application of super phosphate was made to supply 22.4 kg of P_2O_5/ha. Taking into account the amount of P_2O_5 in farm yard manure, the balance quantity of P_2O_5 was applied to N_2 plots. Nitrogen content of straw and grain was estimated by the method described by Humphries (1956) and the protein content for grain was worked out by multiplying with 6.25. Phosphorus content of grain and straw was estimated by Jackson (1962) method. Potassium content of both straw and grain was estimated with the flame photometer.

RESULTS AND DISCUSSION

(i) **Germination study:** Germination study was done in laboratory. Sorghum (CO 20) seeds were soaked in the respective solution for 12 hours and air dried before keeping them in germination trays. Daily germination counts were recorded upto 7th day and are given hereunder.

Pre-soaking treatment	Mean germination percentage (Transformed values)
Unsoaked control	67.8
Water soaking	71.0
5 per cent KH_2PO_4	64.5
10 per cent KH_2PO_4	57.1
20 per cent KH_2PO_4	46.1
500 ppm gibberellic acid	74.6
SED	2.55
CD (P = 0.05)	5.41

Seed soaking with lower concentration of KH_2PO_4 had little effect on germination. Deway (1962) reported reduction in germination when the concentration of solution was increased. Gibberellic acid induced maximum germination and was on par with water soaking treatments. Similar effects of gibberellic acid were reported by Kasperbauer and Gardner (1959) on sorghum seed.

(ii) **Plant height at maturity:** Perusal of the data in Table 1 shows that application of N irrespective of the methods increased the plant height at maturity over control. Application of N $\frac{1}{2}$ soil + $\frac{1}{2}$ foliar (N_3) has resulted in maximum plant height. The data in

Table 2 indicates that initial plant height on 15th day was significantly increased by 500 ppm gibberellic acid (15.8 per cent) and 10 ppm KH_2PO_4 (18.2 per cent) over control. The latter was on par with water soaking. Pillai and Chandhoke (1961) had reported similar effects of gibberellic acid on sorghum.

(iii) **Leaf area:** Total leaf area was calculated as described by stickler *et al.* (1961). The data presented in Table 1 indicates that application of N irrespective of the methods has significantly increased the leaf area over the control. Foliar application (N_3, N_4 and N_5) resulted in greater leaf area though the differences among the

TABLE 1. Effect of methods of application of nitrogen (22.6 kg/ha) on rainfed sorghum (CO 20)

Treatments	Plant Ht. at matutity in cm.	Mean leaf area per plant in sq. cm.	Weight per head in grams	Nitrogen Percentage in straw	Crude protein percentage	Grain yield kg/ha
N_0 — No nitrogen	245.1	704.2	24.24	0.42	9.36	1654.7
N_1 — Soil application of Urea	260.5	864.3	32.23	0.53	10.65	2183.2
N_2 — Farm yard manure	254.3	823.3	86.84	0.47	10.44	2065.1
N_3 — $\frac{1}{2}$ Soil + $\frac{1}{2}$ foliar in two splits	270.7	875.3	32.55	0.51	11.21	2154.6
N_4 — Foliar in two splits	264.9	902.5	28.55	0.50	11.13	2012.6
N_5 — Foliar in three splits	258.5	892.7	30.90	0.47	10.89	2096.1
SE. D.	6.7	63.9	2.48	0.02	0.16	114.5
C. D. (P = 0.05)	13.2	127.2	4.95	0.04	0.32	229.0

N treatments were not significant. Ramachandra Reddy and Mustafa Russain (1968) reported similar results on hybrid sorghum.

(iv) **Weight of the earhead:** Nitrogen application increased the ear weight significantly over no nitrogen treatment N_3 ($\frac{1}{2}$ soil + $\frac{1}{2}$ foliar) has increased the ear weight by 34.2 per cent over control. Among the methods there were no differences, Raheja and Krantz (1958) also reported similar increase of ear weight due to N application over control. The greater weight of the ears may be either due to increased number of grains present or due to heaviness of grains present or due to heaviness of the individual grain or due to heavier glumes and peduncle. The increase in ear weight had resulted in increased grain yield.

(v) **500 grain weight:** Perusal of data in Table 2 shows that KH_2PO_4 and water soaking treatments increased the grain weight over control, while gibberellic acid soaking treatment was on par with the unsoaked control.

The percentages of increase over control were 5.06, 4.19 and 2.34 for S_2, S_1 and S_3 respectively.

(vi) **Nitrogen content in straw:** The results are presented in Table 1. All methods of N application had significantly increased the N percentage over control. The difference among treatments involving the N application were not clear. However the maximum percentage of N in the straw was obtained in N_1 treatment followed by N_3 and N_4. Rai (1965) also obtained similar increase of N content in sorghum straw. More uptake of N and P was seen in KH_2PO_4 treatment followed by water soaking (Table 2) Presoaking in 500 ppm gibberellic acid had not influenced the uptake of NPK due to slender, weak and pale green seedlings.

TABLE 2. Effect of seed soaking on the growth, yield and nutrient content of sorghum (CO./20)

Seed soaking treatmens	Seedling height on 15th day in cm	500 grain weight in gm	Grain yield (kg/ha)	Nutrient content in percentage			
				Straw		Grain	
				Nitrogen	Phosphorus	Potassium	Protein
Untreated control (S_0)	24.4	12.001	1945	0.479	0.0253	0.192	10.667
Water soaking (S_1)	25.5	12.504	2124	0.510	0.0320	0.196	10.442
10 per cent KH_2PO_4 (S_2)	26.4	12.609	2291	0.529	0.0305	0.198	10.725
500 ppm Gibberellic acid (S_3)	28.2	12.282	1766	0.434	0.0261	0.205	10.446
SE. D.	0.5	0.227	154	0.226	0.0126	0.009	0.168
CD. (P=0.05)	1.4	0.487	321	—	—	—	—

(vii) **Crude protein in grain:** Application of N had significantly increased the crude protein content of sorghum grain over the control. It is interesting to note that the foliar treatments N_3 and N_4 had resulted in higher crude protein of the grain as compared to soil application. N_3 ($\frac{1}{2}$ soil + $\frac{1}{2}$ foliar) treatment had resulted in maximum protein content of grain followed by N_4 and N_5. Burleson *et al.* (1956) reported increased protein content of sorghum grain by N application. Application of N in general not only increased the grain yield but also increased the protein content of the grain. A part of the N can be applied through foliage to get increased protein content in rainfed sorghum.

(viii) **Grain yield:** Perusal of the data presented in Table 1, indicates that application of N irrespective of the methods had significantly increased the grain yield over control. Highest grain yield was obtained in N_1 (soil application) treatment followed by N_3 ($\frac{1}{2}$ soil + $\frac{1}{2}$ foliar). The increased grain yield in N_1 and N_3 was due to

the cumulative effect of plant height, leaf area, and weight of earheads. Similar yield increase due to N application was obtained in sorghum by Kaliappan (1962). The data in Table 2 reveals that presoaking in 10ppm KH_2PO_4 solution had significantly increased the grain yield upto 17.8 per cent over control and was due to plant growth, more uptake of nutrients and 500 grain weight. Gibberellic acid was on par with control. Water soaking treatment was superior to gibberellic acid but not over control. The stem elongation caused by gibberellic acid had resulted slender, weak and pale green seedlings. Pillai and Chandoke (1961) and pauli and stickle (1961) remarked that gibberellic acid did not have much favourable influence on sorghum growth and yield except at very great dilution.

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