V. COMPARISON OF SEED DRESSING AND SOIL APPLICATION OF MACRO AND MICRO NUTRIENTS IN GROUNDNUT IN CALCAREOUS SOIL

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ABSTRACT

To test the effectiveness of methods of nutrient application in field grown groundnut crop, various micronutrient salts (borax, boric acid, copper sulphate, copper acetate, copper chloride, ferrous sulphate, ferric chloride, manganese sulphate, manganese chloride, and zinc sulphate, zinc chloride) at a rate of 5 kg/ha and macronutrients salts (calcium chloride, calcium nitrate, potassium dihydrogen orthophosphate, potassium chloride) at 10 kg/ha were compared by applying as seed dressing, and also in the furrows in the soil opened for sowing groundnut seed. The mean data of the two application methods revealed that, in general, most of the micronutrient salts and calcium chloride showed their positive response to groundnut grown in calcareous soil and increased the number of pods, pod yield, shelling per cent, oil content and seed size of groundnut over control. However, there was interaction among the various nutrients and their methods of applications on the yields and other parameters. When these nutrients were applied as seed dressing, only copper sulphate, copper acetate, ferrous sulphate, manganese sulphate, and calcium chloride could increase the yield and other parameters. Boric acid, copper chloride, manganese chloride, zinc chloride, zinc sulphate, ferric chloride, calcium nitrate, potassium dihydrogen orthophosphate and potassium chloride when applied as Seed dressing caused damage to seed, and reduction in field germination hence should not be used.

Interestingly, response of copper sulphate, manganese sulphate, calcium chloride and ferrous sulphate as seed dressing was extraordinary and hence these should be used as seed dressing only. On the other hand boric acid, borax, copper acetate, copper chloride, were better as soil application and hence should be used as soil application.

KEY WORDS: Seed dressing, micro and macro nutrients

INTRODUCTION

Groundnut (*Arachis hypogaea* L.), due to its underground pod bearing habit, is grown mainly on light-textured soils which are generally deficient in mineral nutrients (Kanwar et al., 1983; Singh, 1999). Because of high calcium requirement of groundnut, the farmers in India prefer to grow this crop in calcareous soil, where chlorosis, due mainly to the lime-induced deficiencies of nutrients, is the main problem causing reduction in pod yield (Singh et al., 1993; Singh and Chaudhari, 1997). The mineral nutrients salts are applied in the field to recover the plants from their deficiencies, either through soil, seed or through foliar applications (Singh, 1999; Singh *et al*., 1990, 1993). For the best use of these, it is essential that these nutrients, particularly of micronutrients, are applied near the root zone through seed coating, but some of the nutrient-containing salts are toxic if come into direct contact with seeds and roots. Now-a-days several macro and micro-nutrient salts are being recommended for field application and hence it was felt necessary to test, through field experimentation, some of the commonly used nutrient salts for their application as seed coating and their comparison with furrow application in soil for their suitability in groundnut.

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MATERIALS AND METHODS

A field experiment was conducted during wet seasons at the research farm of the National Research Centre for Groundnut, Junagadh, India in a medium black, calcareous (21 % $CaCO_3$) clayey soil containing, 7.8 pH, 0.81 % organic carbon, 710 mg/kg total N, 6.2 mg/kg available P (Olsen P), 11 mg/kg heat soluble S (available S), 3.02, 4.9, 0.61 and 0.60 mg/kg DTPA extractable Fe, Mn, Zn, and Cu, respectively and 0.36 mg/kg water extractable B, 0.26 mg/kg Mo. The experiment was laid out in a factorial randomized block design with two modes of application (through seed and through furrow in soil) in the main plots and sixteen treatments (as detailed in Table 1) in the sub-plots. There were three replications. The field was prepared, 10 cm deep furrows, distanced at 30 cm were opened and then divided into 96 plots of 12 m^2 (4 m x 3 m) by raising bunds.

There were eleven (1-11) micronutrient and four (12-15) macronutrient and treatments, the chemical salts of which were applied at a rate of 5 and 10 kg/ha, respectively using two (seed and soil) mode of application. Also there was a control. To apply through seed, these salts were mixed with the water soaked seed and shaken uniformly so as to make a coating of these salts around the seed and then sown in the furrows. In the other method the nutrient salts were applied in the furrows. The N, P, K, at 40, 40 and 60, kg ha^{-1}, respectively, was applied at the time of sowing, in the furrows uniformly, in all the treatments.

The groundnut genotype, FeESG 10-1 was grown following recommended package of practices. The damage to seed and seedlings due to seed coating and furrow application of nutrients and percent germination were recorded in the field. The crop was harvested at maturity, and observations on yield and related attributes recorded.

The plant samples were analyzed for micronutrients- Fe, Mn, Zn and Cu were estimated by atomic absorption spectrophotometry while B and Mo by colorometrically using curcumine and thiocynate methods, respectively. All these data were analysed statistically.

RESULTS AND DISCUSSIONS

The mean data of the two application methods revealed that, in general, most of the micronutrient salts and calcium chloride showed their positive response to groundnut grown in calcareous soil and increased the number of pods, pod yield, shelling per cent, oil content and seed size of groundnut significantly over control (Table 1 and 2). However, the haulm yield increased due to application of potassium chloride, calcium chloride and zinc sulphate only. The calcium nitrate, potassium dihydrogen orthophosphate and potassium chloride, did not influenced the pod yield. This indicated that most of these micro- and macro-nutrients at their doses of 5 and 10 kg/ha chemical fertilizers, respectively did not influence the haulm yield and the effect was restricted only to pod yield. As such there is not much problem of dry matter accumulation in groundnut, however, there is problem of partitioning and these nutrients probably increased the same and harvest index.

There was significant interaction among the various methods of nutrient application and nutrient treatments on the yields and other parameters (Table 1 and 2). When these nutrients were applied as soil application in the furrows, most of these showed positive response and increased the pod yield, pod number and oil content. But, as seed dressing, copper sulphate, copper acetate, ferrous sulphate, manganese sulphate and calcium chloride, only, could increase the pod yield, pod number and other parameters. In general, the groundnut seed took 6 days for their germination and the study reveals that, chloride salts of various micronutrients were toxic to groundnut seed, as seed coating with copper chloride, boric acid and ferric chloride delayed field emergence and reduce germination percentage. Among these chemicals, iron chloride, boric acid and copper chloride were more deleterious when applied as seed than their soil application. However when these were applied through soil showed normal germination.

Seed dressing with boric acid, copper chloride and ferric chloride among the micronutrients and calcium nitrate, potassium dihydrogen orthophosphate and potassium chloride among the macronutrients caused damage to seed initially, as a result reduction in field germination was observed and hence these could not cope up with growth and field cover to produce significant increase in yield and other parameters. Thus, these should not be used as seed dressing. Interestingly, response of copper sulphate, manganese sulphate and calcium chloride and ferrous sulphate as seed dressing was extraordinary and better than their soil application, and hence these should be used as seed dressing only. On the other hand application of boric acid, borax, copper acetate, copper chloride, were better as soil than seed and hence these should be used as soil application.

The increase in oil content was observed due to application of borax, manganese chloride, potassium chloride and potassium dihydrogen orthophosphate applied either through seed or in soil and also due to soil application of copper acetate, ferric chloride, ferrous sulphate, manganese sulphate, zinc chloride, zinc sulphate, and calcium chloride (Table 2). The shelling percent increased due to application of borax, copper chloride, copper acetate, ferrous sulphate, manganese sulphate and zinc chloride through seed and also due to soil application of copper acetate, manganese sulphate, and zinc chloride. However the 100-seed wt. was increased due to application of borax, ferrous sulphate and manganese sulphate and zinc chloride only. Indicating that these nutrients played their important role in increasing various parameters and hence their application is essential.

Though role of external application of micronutrients in increasing the yields and yield attributes, in calcareous soil, is well known (singh, 1999; Singh et al 1990; Singh and Chaudhari , 1997), the present study has clearly demonstrated the effectiveness of various application methods and of chemicals which will have its own significance for direct application in the field. The chlorine and B containing chemicals , as seed coating damaged groundnut seeds but these were found responding well when applied in the soil in the furrows opened for sowing seeds.

Thus it is concluded that the copper sulphate, manganese sulphate, ferrous sulphate and calcium chloride should be used as seed dressing and boric acid, borax, copper acetate, copper chloride, as soil application in the furrows opened for sowing groundnut seed.

References

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Table 1: Influence of micro- and macro-nutrients and their mode of application on the pod and haulm yields of groundnut genotypes FeESG 10 during Wet 1995.

S N	Treatment	Pod yield (kg/ha)			Haulm Yield (kg/ha)			Pods/plant		
		Seed	Soil	Mean	Seed	Soil	Mean	Seed	Soil	Mean
1.	Borax	1211	1399	1305	3000	3433	3217	7.7	8.0	7.9
2.	Boric acid	862	1460	1161	3522	3356	3434	7.0	8.6	7.8
3.	Copper sulphate	1502	1311	1407	3733	3578	3656	9.3	9.7	9.5
4.	Copper acetate	1232	1328	1280	3800	3644	3722	8.7	8.7	8.7
5.	Copper chloride	920	1432	1176	2256	3789	3022	7.3	8.0	7.6
6.	Ferrous sulphate	1393	1258	1326	3178	3156	3167	9.0	8.7	8.8
7.	Ferric chloride	1114	1200	1157	2689	3022	2856	7.0	7.6	7.3
8.	Manganese sulphate	1309	1098	1203	3022	3178	3100	8.0	8.3	8.1
9.	Manganese chloride	1141	1152	1147	3267	3133	3200	7.0	6.7	6.9
10.	Zinc chloride	1147	1200	1173	3356	3356	3356	7.3	7.3	7.3
11.	Zinc sulphate	1118	1169	1143	3222	4289	3756	7.7	7.7	7.7
12.	Calcium chloride	1438	1047	1242	4933	4444	4689	8.7	8.3	8.5
13.	Calcium nitrate	968	928	948	2800	3356	3078	7.3	7.0	7.2
14.	Potassium dihydrogen ortho phosphate	838	1068	953	3156	3600	3378	7.0	7.7	7.4
15.	Potassium chloride	951	1151	1051	3622	4156	3889	6.7	7.7	7.0
16.	Control	950	950	950	3167	3167	3167	6.3	6.3	6.3
	Mean	1131	1197		3295	3541		7.6	8.0	
	LSD (0.05)									
	Application mode		64			205			0.3	
	Treatments		183			586			0.9	
	Interaction		259			830			1.2	

Table 2: Influence of micro- and macro-nutrients and their mode of application on the oil content, shelling and 100-seed weight of groundnut genotypes FeESG 10 during Wet, 1995.

S N	Treatment	Oil %			Shelling %			100-seed wt.		
		Seed	Soil	Mean	Seed	Soil	Mean	Seed	Soil	Mean
1.	Borax	50.6	49.5	50.1	66.2	62.8	64.5	26.5	29.1	27.8
2.	Boric acid	49.7	49.9	49.8	63.7	62.5	63.1	24.7	25.9	25.3
3.	Copper sulphate	49.1	49.1	49.1	64.8	64.1	64.5	25.4	24.8	25.1
4.	Copper acetate	49.4	50.9	50.2	66.0	66.2	66.1	25.3	26.1	25.7
5.	Copper chloride	48.9	50.2	49.6	65.4	63.6	64.5	25.7	26.9	26.3
6.	Iron sulphate	50.2	51.1	50.7	65.5	64.5	65.0	26.4	26.7	26.5
7.	Iron chloride	49.2	51.0	50.1	63.0	62.1	62.5	25.5	26.8	26.2
8.	Manganese sulphate	49.7	51.0	50.4	65.7	66.0	65.8	26.5	27.0	26.7
9.	Manganese chloride	50.5	52.6	51.5	64.7	60.0	62.4	24.2	24.6	24.4
10.	Zinc chloride	50.4	52.6	50.5	65.0	61.0	63.0	28.0	27.1	27.6
11.	Zinc sulphate	49.9	51.1	50.5	62.6	65.3	64.0	23.9	27.0	25.5
12.	Calcium chloride	49.6	50.5	50.1	63.5	63.2	63.3	26.3	24.8	25.6
13.	Calcium nitrate	50.2	50.2	50.2	61.8	63.2	62.5	22.9	24.0	23.4
14.	Potassium dihydrogen ortho phosphate	50.6	51.8	51.2	60.6	65.2	62.9	24.5	24.5	24.5
15.	Potassium chloride	51.2	49.6	50.9	62.9	60.9	61.9	24.9	23.5	24.1
16.	Control	48.5	48.5	48.5	61.0	61.0	61.0	24.4	24.4	24.4
	Mean	49.9	50.6		63.9	63.2		25.3	25.8	
	LSD (0.05)									
	Application mode		0.46			NS			NS	
	Treatments		1.31			2.8			2.0	
	Interaction		1.86			3.9			2.8	