position of head on mother plant did not influence the productivity and seedling vigour. But, the seeds collected from secondary heads recorded numerically higher yield by 2.56 % compared to primary 0.38 % over bulk seeds. But on the other hand, the observation on germination (%) and oil content exerted a significant influence due to position of heads on plant in safflower. The seeds obtained from secondary heads recorded higher germination which might be due to accumulation of more food materials needed for germination. In cotton also Thiagarajan (1977) reported that seeds from second picking are superior over first and third pickings. But, the oil content was lower in secondary head than other positions and bulk. It could be observed that seeds harvested in bulk irrespective of position of the mother plant could be used for commercial purpose. Since, the germination of seeds of secondary head are comparatively superior with lesser oil content these seeds could be utilized for carry over purpose of highly valuable seeds like nucleus (or) breeder seed.

References

Akilan, V. (1986). Studies on seed production, processing and viability testing in coriander *(Coriandrum sativum* Linn.), M.Sc. (Ag) Thesis, Tamil Nadu Agricultural University, Coimbatore.

AOAC. (1960). Oils, Fats and Waxes. Official method of analysis. Washington : 358 - 378.

Panse, V.G. and Sukhatme, P.V. (1967). Statistical methods for Agricultural Workers, ICAR Pub., New Delhi.

Sundaralingam, K. (1995). Seed technological studies in carrot *(Daucus carota* L) cv. Zino. M.Sc (Ag) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Thiagarajan, C.P. (1977). Studies on the development, maturation and quality of cotton seed. M.Sc.(Ag) Thesis, Tamil Nadu Agricultural University, Coimbatore.

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Research Notes

Effect of micronutrients and sulphur on yield and nutrient uptake by maize in an alfisol

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Maize is the fourth major grain crop grown in Tamil Nadu for poultry feed. Intensive cropping coupled with introduction of high yielding varieties have extensively exhausted the soil fertility with respect to macro and micronutrients. Further, use of S free fertilizers has caused depletion of S in soils. Zinc deficiency in Indian soils and responses to its application on various crops has been reported earlier (Singh, 1999). Next to Zn, B deficiency is wide spread in many soils and in calcareous and coarse textured soils in particular leading to low crop yields. The research carried out on the use of organics

Table 1. Effect of treatments on grain and stover yield of maize and soil fertility

T.No	Treatments	Yield (kg ha^{-1})		Post harvest soil fertility (mg kg^{-1})			
		Grain	Stover	B	Zn	Fe	S
T_1	Control	4214	5300	0.160	0.76	2.96	11.2
T_2	1.25 kg Zn ha^{-1} as enriched FYM	4703	6867	0.175	0.85	3.08	11.8
T_3	2.5 kg Zn ha^{-1} as enriched FYM	4721	5967	0.200	0.88	3.06	12.0
T_4	5.0 kg Zn ha^{-1} as enriched FYM	5104	6433	0.225	1.01	3.04	12.1
T_5	2.5 kg Zn + 1.5 kg B ha^{-1} as enriched FYM	5632	6500	0.240	1.03	3.10	12.0
T_6	2.5 kg Zn ha^{-1} as enriched CCP	5218	6433	0.210	0.98	3.04	12.0
T_7	5.0 kg Zn + 1.5 kg B + 5.0 kg Fe ha^{-1}	5901	6600	0.230	0.96	3.12	12.2
T_8	5.0 kg Zn ha^{-1} alone	5097	6450	0.180	0.94	3.00	12.2
T_9	5.0 kg Zn+ 20 kg S ha^{-1}	5708	7867	0.190	0.92	3.02	13.6
T_{10}	5.0 kg Zn + 40 kg S ha^{-1}	5979	7900	0.220	0.96	3.04	13.8
T_{11}	5.0 kg Zn + 40 kg S + 1.5 kg B ha^{-1}	6410	7933	0.265	1.00	3.10	14.2
T_{12}	5.0 kg Zn + 40 kg S + 1.5 kg B + 0.5 kg Mo ha^{-1}	6342	7783	0.260	0.98	3.08	14.1
	CD (P = 0.05)	417.9	1079.4	0.015	0.14	NS	0.66

Table 2. Content and uptake of Micronutrients and S in maize grain and stover

T.No.	Nutrient content						Nutrient uptake					
	B(mg kg^{-1})		Zn(mg kg^{-1})		S(%)		B(g ha^{-1})		Zn(g ha^{-1})		S (kg ha^{-1})	
	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
T_1	36.6	37.16	29.7	32.1	0.165	0.131	154.4	196.9	125.2	170.1	6.95	6.94
T_2	38.6	38.30	24.0	35.8	0.201	0.194	181.6	263.0	112.9	245.8	9.45	13.32
T_3	31.5	33.74	25.6	43.6	0.188	0.231	148.7	201.3	120.9	260.2	8.88	13.78
T_4	63.5	37.64	48.1	52.9	0.215	0.196	324.2	242.1	245.5	340.3	10.97	12.61
T_5	49.2	37.22	56.9	53.0	0.220	0.234	276.8	241.9	320.5	344.5	12.39	15.21
T_6	62.7	32.79	73.5	79.3	0.235	0.239	327.3	210.9	383.5	510.1	12.26	15.37
T_7	57.7	42.28	38.6	80.6	0.245	0.233	340.6	279.0	227.8	532.0	14.46	15.38
T_8	48.1	33.07	52.9	82.7	0.226	0.230	245.1	213.3	269.6	533.4	11.52	14.84
T_9	57.1	32.46	69.7	86.2	0.261	0.242	325.7	255.4	397.8	678.1	14.90	19.04
T_{10}	44.7	29.79	72.6	88.4	0.266	0.272	267.1	235.3	434.1	698.4	15.90	21.49
T_{11}	34.3	32.46	79.1	92.7	0.244	0.245	219.6	257.5	507.0	735.4	15.64	19.44
T_{12}	46.1	33.23	70.6	90.9	0.215	0.235	292.6	258.6	447.7	707.0	13.64	18.29
CD (P = 0.05)	7.21	NS	9.89	4.63	0.034	0.068	21.7	34.3	38.6	50.6	1.84	1.08

viz., FYM, coirpith, biogas slurry and poultry manure as source of micronutrients was found effective in reducing the dose of added micronutrients. During the incubation, the nutrient ions are subjected to chemical equlibrium reaction which results in the formation of complexed and organic acid bound ions. Among the secondary and micronutrients, S, Zn and B have a specific vital role in growth and development of crops. In the present study, attempts had been made to evaluate the effect of application of micronutrients and S on yield and uptake of maize.

A field experiment was conducted during 2002 - 2003 in a farmer's holding at Putthur, Thondamutthur block, Coimbatore district. Totally there were twelve treatments *viz.*, T_1: Control, T_2 : 1.25 kg Zn ha^{-1} as enriched FYM, T_3 : 2.50 kg Zn ha^{-1} as enriched FYM, T_4 : 5.0 kg Zn ha^{-1} as enriched FYM, T_5 : 2.50 kg Zn W + 1.5 kg B ha^{-1} as enriched, FYM, T_6 : 2.50 kg Zn ha^{-1} as enriched CCP, T_7 : 5.0 kg Zn + 1.5 kg B + 5.0 kg Fe ha^{-1}, T_8 : 5.0 kg Zn ha^{-1} alone, T_9 : 5.0 kg Zn + 20 kg S ha^{-1}. T_{10} : 5.0 kg Zn + 40 kg S ha^{-1},T_{11}, : 5.0 kg Zn + 40 kg S + 1.5 kg B ha^{-1} , T_{12} : 5.0 kg Zn + 40 kg S + 1.5 kg *B* + 0.5 kg Mo ha^{-1}. The experiment was conducted in a randomized block design with three replications. The experimental soil was free from sodicity (pH: 7.8) and salinity (EC: 0.35 dS m^{-1}). The soil was found to be deficient in HWS-B (0.38 mg kg^{-1}), DTPA Zn (0.96 mg kg^{-1}), Fe (3.32 mg kg^{-1}) and S (11.6 mg kg^{-1}) and sufficient in Cu (2.13 mg kg^{-1}) and Mn (12.2 mg kg^{-1}). The crop was harvested at maturity and yields of grain and stover were recorded. Grain and stover samples were dried, powdered and digested in diacid mixture (4:1 HNO_3 - $HC10_4$) analyzed for Zn (Lindsay and Norvell, 1978), B (Page *et al.*, 1982) and S by turbidimetrically with $BaCl_2$ (Jackson, 1973) and the uptake values were computed. Soil samples were collected and analyzed for DTPA extractable Zn (Lindsay and Norvell, 1978), HWS - B (Gupta, 1967) and S (Williams and Steinbergs, 1959).

The grain and stover yields ranged from 4214 to 6410 kg ha^{-1} and 5300 to 7933 kg ha^{-1} respectively. The treatment that received 5.0 kg Zn + 40 kg S + 1.5 kg B ha^{-1} (T_{11}) registered the highest grain yield (6410 kg ha^{-1}) which produced comparable to T_{12} (5.0 kg Zn + 40 kg S + 1.5 kg B + 0.5 kg Mo ha^{-1}) which produced 6342 kg grain ha^{-1} (Table 1) was found superior over the rest. Application of Mo did not influence on the yield of maize. The yield increase in the said treatments were 52.1 and 50.5 per cent respectively over NPK control (T_{11}). Islam *et al.* (1997) reported a yield increase of 41.8 per cent due to the application of Zn + B + S in rice - mustard cropping system. The yield increase in the remaining treatments fell in the range of 11.6 to 41.9 per cent. The control treatment registered the lowest grain and stover yields of 4214 and 5300 kg ha^{-1}, respectively. Enrichment of FYM or CP with Zn had a pronounced effect on the yield increase over control to the tune of 10 - 15 per cent regardless of the levels of Zn. The increased yield might be due to the release of organic legands which would have assisted in enhanced availability of micronutrients and their uptake.

The grain B content ranged from 31.5 to 63.5 mg kg^{-1} while in stover, it ranged from 29.8 to 42.3 mg kg^{-1}. However the differences were significant only for grain- (Table 2). The treatment T_1 (Zn 5.0 + S 40 + B 1.5 kg ha^{-1}) registered higher Zn content (79.1 and 92.7 mg kg^{-1} in grain and stover, respectively). In the same treatment, grain had the highest S content comparable to T_9 (0.26%) and T_{11} (0.24%). The treatments that received S registered higher values than the others. Increase in S content due to S application in chickpea was earlier reported by Tripathi *et al.* (1997). The lowest S content of 0.165 per cent in grain and 0.131 per cent in stover were observed in control. The exclusion of micronutrients and S had lowered the concentrations of all the nutrients.

The uptake of nutrients at the harvest was higher in all the treatments in comparison to NPK control (T_1). Soil application of 5.0 kg Zn + 40 kg S + 1.5 kg B ha^{-1} (T_{11}) had higher grain Zn uptake while T_7 accounted for higher B uptake (Table 2). Regarding the S uptake, application of 5.0 kg Zn + 40 kg S ha^{-1} (T_{10}) registered higher uptake of 15.9 kg ha^{-1} in grain closely followed by T_{11} with 15.6 kg ha^{-1} and T_9, T_7 and T_{12} treatments. Patgiri (1995) reported increased B uptake in Toria due to B + S application while Islam *et al.* (1997) observed higher Zn, B and S uptake in rice - mustard sequence due to the application of respective nutrients. The increased uptake of these nutrients due to their application in the present study corroborates with the findings of Dwivedi *et al.* (2002). The lowest uptake of all the nutrients was observed in control.

In the stover, the highest B uptake of 279 g ha^{-1} was registered by the treatment of 5.0 kg Zn + 1.5 kg B + 5.0 kg Fe ha^{-1} (T_7) followed by T_9 and T_{11} which were on par but superior over all other treatments. The higher Zn uptake was accounted by T_{11} (735 g ha^{-1}) but was on par with T_{10} and T_{12} and superior over other treatments. However, T_{10} exhibited higher uptake values for S (21.5 kg ha^{-1}) closely followed by T_{11}. The (T_1) control recorded lower uptake values for all the nutrients studied. Misra (2001) observed that the total uptake of Zn and S had increased in mustard due to the application of Zn and S.

Among the micronutrients, availability of B and Zn was significantly altered by various treatments (Table l).The treatments involving Zn application registered higher DTPA Zn and the treatment of 2.5 kg Zn + 1.5 kg B ha^{-1} enriched FYM (T_5) accounted for higher value of 1.03 mg kg^{-1} followed by 5.0 kg Zn ha^{-1}) enriched with FYM (T_4) with 1.01 mg kg^{-1}. These treatments were on par with other treatments with higher level of Zn or Zn + B. Regarding HWS - B, treatment T_{11} registered higher value (0.265 mg kg^{-1}) followed by T_{12} (0.26 mg kg^{-1}). Islam *et al.* (1997) had also reported improvement in available nutrient status of soil after the harvest due to Zn, B and S application. However, no significant differences were observed in DTPA Fe due to imposition of various treatments and the availability ranged from 2.96 to 3.12 mg kg^{-1}. The 0.15% CaCN S ranged from 11.2 to 14.2 mg kg^{-1}, the highest (14.2 mg kg^{-1}) value being in T_{11} (5 kg Zn + 40 kg S + 1.5 kg B ha) followed by T_{12} (14.1 mg kg^{-1}). However, these two treatments were on par with other S applied treatments (T_9 and T_{10}) and superior over others and control. The control recorded lower values for the secondary and micronutrients studied.

References

Dwivedi, S.K., Singh, R.S. and Dwivedi, K..N. (2002). Effect of sulphur and zinc nutrition on yield and quality of maize in Typic Ustochrept soil of Kanpur. *J. Indian Soc. Soil Sci.,* **50(l):**70-74

Gupta, V.C. (1967). A simplified method for determining hot water soluble boron in podzol soils. *Soil Sci.,* **103 :** 424 - 428.

Islam, MR., Raisat, T.M. and Jahiruddin, M. (1997). Direct and residual effect of S, Zn and B on yield and nutrient uptake in a rice - mustard cropping system. *J. Indian Soc. Soil Sci.,* **45(1) :** 126- 129.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice Hall of India, New Delhi.

Lindsay, W.L. and Norvel, W.A. (1978). Development of a DTPA soil test for zinc, iron, manganese and copper. *Soil Sci. Soc. Am. J.,* **42 :** 421 - 428.

Misra, S.K. (2001). Effect of sulphur and zinc on yield, uptake of nutrients and quality of mustard. *Ann. Pl. Soil Res.,* **3 (2) :** 206 - 213.

Page, A.L., Miller, R.H. and Keeney, D.R. (1982). Methods of Soil Analysis. Part.2. S.No 9. *Amer. Soc. Agron., Inc., Madison,* U.S.A.

Patgiri, D.K. (1995). Effect of boron, sulphur and molybdenum on Toria *(Brassica campestris* L.) in a Typic Haplaquept. *J. Indian Soc. Soil Sci.,* **43 :** 295-296.

Singh, M.V. (1999). Experiences of AICRP on micro and secondary nutrients and pollutant elements in soils and plants. *Fert. News,* **44 (4) :** 63 - 82

Tripathi, H.C., Singh, R.S. and Mishra, V.K. (1997). Effect of S and Zn nutrition on yield and quality of chickpea *(Cicer arietinum L). J. Indian Soc. Soil Sci.,* **45(1) :** 123-126.

Williams, C.H. and Steinbergs, A. (1959). Soil sulphur fractions as chemical indices of available sulphur in some Australian soils. *Anst. J. Agri. Res.,* **10 :** 340 - 352.

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Research Notes

Tractor Reliability

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Reliability in engineering is defined as the probability that a device will satisfactorily perform its specified function for a specified period of time under a given set of operating conditions. Reliability is thus a mathematical expression of the likelihood of satisfactory operation. Though the repair cost of tractor is high the subsequent loss due to delay in carrying out the repair is potentially much greater than the cost of repair. Under such condition any stoppage of tractor can cause sizeable loss, due to delay in carrying out the timeliness of farm operations during the peak seasons apart from inefficient labour utilization. Hence the reliability of tractor has become more important, while the breakdown of an individual subsystem of a tractor is an annoyance (Behl *et al.,* 1987).

It is strongly believed that the application of reliability theory is feasible and necessary for proper utilisation of the tractor for time