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Identification of Nutrient Deficiencies in Maize Based on Conventional Critical Nutrient Concentration (Cnc)

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ABSTRACT

A crop leaf nutrient survey was carried out in Karimnagar, Nizamabad and Warangal districts of Andhra Pradesh to identify the nutrient deficiencies if any in maize based on conventional Critical Nutrient Concentration (CNC). Index leaves (ear leaves opposite to cob at silking or tasseling stage) were collected at random from the 150 selected fields covering 50 locations in each district in 10 mandals covering 3-5 locations in each mandal for the analysis of nutrients. 15-20 index leaves at random were collected in each field and composite sample was prepared and analyzed for N, P, K, Zn, Cu, Fe and Mn following standard procedures. The deficient nutrients were identified (N, P, K, Zn, Cu, Fe and Mn) based on the Critical Nutrient Concentration (CNC). The extent of nutrient deficiencies were changed depending up on the critical level adopted.

Key words : Critical Nutrient Concentration (CNC), Index leaves and silking or tasseling stage

Maize is an important crop grown in Andhra Pradesh in an area of 7.83 lakh hectares with the production of 27.61 lakh tonnes (DES, 2010). Thirty one percent of the total maize area and twenty nine percent of the total production in this state is located in three districts *viz.* Karimnagar, Nizamabad and Warangal. Foliar analysis is usually considered to be an important method for monitoring the nutrient status of the plants and to identify the nutrient deficiencies. The interpretation is done based on comparing the level of nutrient (s) in the index tissue with critical or optimum range of the concerned nutrient. In case of maize, the indicated tissue to be sampled has been identified as ear leaf (leaf opposite to cob at tasseling or silking stage) of the plant (Escano *et al*., 1981 and Walworth *et al*., 1988). In the conventional approach, the diagnosis of nutrient deficiencies was done on the basis of actual tissue concentrations comparing with Critical Nutrient Concentrations (CNC) or Sufficiency Range (SR) of the nutrients. In case of maize, critical level(s) of nutrients to identify nutritional imbalances and deficiencies have been reported by Melsted *et al*. (1969), Neubert *et al.* (1969) and Jones *et al.* (1990). These critical levels have been developed outside the state of Andhra Pradesh. There are always some variations among the critical levels suggested by different workers for the same crop. This study was carried out to know the how much of variation in identification of nutrient deficiencies in maize by above workers. The objectives were.

1) To find out the nutrient status of soils and plants in maize growing areas in Karimnagar, Nizamabad and Warangal districts of Andhra Pradesh
2) To identify the nutritional disorders, if any in maize, based on Critical Nutrient Concentration (CNC) in the index tissue.
3) To develop the DRIS norms and indices for maize
4) To identify the yield limiting nutrients in maize using developed DRIS norms and indices
5) Evaluating the DRIS norms and indices for their effectiveness and validity.

MATERIAL AND METHODS

Index leaves (ear leaves opposite to cob at silking or tasseling stage) were collected at random from the 150 selected fields covering 50 locations in each district in 10 mandals covering 3-5 locations in each mandal for the analysis of nutrients. 15-20 index leaves at random were collected in each field and composite sample was prepared. Leaf samples collected were immediately washed first with tap water followed by 0.1 N HCl and then followed by repeated washings with running tap water. The samples were then rinsed in distilled water and finally with double distilled water. They were first dried under shade and then in hot air oven at 70^0C. Oven dried plant samples were powdered in a stainless steel grinder to a fineness of 40 mesh and

stored in butter paper covers. Powdered plant samples were analyzed for N, P, K, Zn, Cu, Fe and Mn following standard procedures.

0.1g of sample was weighed, digested with 1 ml of concentrated sulphuric acid and the organic matter was oxidised using 30% hydrogen peroxide drop by drop. The digested material was distilled by microkjeldahl method with 10 ml of 40% sodium hydroxide. The ammonia thus released was collected in 4% boric acid mixed with bromocresol green and methyl red mixed indicator. This was titrated against 0.02N sulphuric acid and nitrogen content of samples were calculated (AOAC, 1980)

The powdered leaf sample of 1g was digested with 10 ml of diacid mixture of nitric acid and perchloric acid with a ratio of 5:2. The digested material was diluted making to 25 ml with double distilled water and filtered. This extract was used for the estimation of Zn, Cu, Fe and Mn. The extract was further diluted for analysis of P and K and accordingly calculated (Wall *et al*., 1980).

Phosphorus was estimated in the diacid extract by vanadomolybdate phosphoric yellow colour method as described by Jackson (1973) and potassium was estimated with flame photometer method (Muhr *et al.,* 1965) and expressed in per cent.

The micronutrient contents in diacid extract were measured with Atomic Absorption Spectrophotometer of model Varian 240 FS (AOAC, 1980) and expressed in mg kg^{-1}.

RESULTS AND DISCUSSION

Nitrogen, phosphorus and potassium in index leaves:

The deficient nutrients were identified based on the critical nutrient concentration as suggested by Melsted *et al*. (1969), Neubert *et al*. (1969) and Jones *et al.* (1990). Standards suggested by these workers are presented in Table 1 below.

Nutrients identified as deficient in index tissues of maize based on the above standards in 150 fields of 30 mandals in three districts under study were given in Tables 2, 3 and 4. The N content of leaf samples selected for study were deficient in 150 ,110 and 146 locations out of total 150 locations, as per the standards given by Melsted *et al,* (1969), Neubert *et al*. (1969) and Jones *et al*. (1990), respectively (Table 2). The mean leaf N contents in 30 mandals selected for study were deficient, as per the standards given by Melsted *et al.* (1969), and Jones *et al*. (1990). Leaf samples of 26 mandals out of 30 mandals selected for study, were deficient in mean N content (Table 3) as per the standards given by Neubert *et al*. (1969). Mean nitrogen content was deficient in maize leaf samples of all the three districts selected for study (Table 4), as per the standards given by Melsted *et al.* (1969), Neubert *et al*. (1969) and Jones *et al*. (1990).

Phosphorus content of leaf samples selected for study were deficient in 18 fields out of 150. When mean P content of leaf tissues taken into consideration, 2 mandals out of total 30 mandals were deficient in phosphorus content. If district overall means are observed, all the three districts had adequate phosphorus, based on the critical levels suggested by Melsted *et al.* (1969), Neubert *et al*. (1969) and Jones *et al*. (1990).

Potassium content was sufficient in all fields in all thirty mandals in three districts selected for study, based on standards suggestd by Melsted *et al.* (1969), Neubert *et al*. (1969) and Jones *et al*. (1990).

Micronutrients in index leaves:

Zn content was deficient in 10, 98 and 26 fields out of 150 fields selected for study as per the standards given by Melsted *et al.* (1969), Neubert *et al*. (1969) and Jones *et al*. (1990), respectively (Table 2). Similarly, when mean contents of mandals were taken into consideration, 1, 23 and 2 mandals out of total 30 mandals were deficient in Zn content as per the standards mentioned above (Table 3). When district mean Zn content is considered, Zn content was sufficient in all the three districts (Table 4) as per the standards given by Melsted *et al.* (1969) and Jones *et al*. (1990) and was deficient in all the three districts as per the reference given by Neubert *et al*. (1969).

Cu content was deficient in 1, 5 and 1 locations out of 150 fields selected for study as per the standards given by Melsted *et al.* (1969), Neubert *et al*. (1969) and Jones *et al*. (1990), respectively (Table 2). No mandal out of total 30 mandals was deficient in Cu content (Table 3). Mean Cu content was sufficient in all the three districts (Table 4) based on the standards suggested by Melsted *et al.* (1969), Neubert *et al*. (1969) and Jones *et al*. (1990).

No deficieny of Fe was observed in all the 150 fields, in 30 mandals of three districts selected for study (Tables 2, 3 and 4). as per the standards given by Melsted *et al.* (1969), Neubert *et al*. (1969) and Jones *et al*. (1990). Mn content was not deficient in all the 150 fields, of 30 mandals in three districts selected for study (Tables 2, 3 and 4) as per the standards given by Melsted *et al.,* (1969), Neubert *et al*., (1969) and Jones *et al*., (1990).

Table 1. Critical Nutrient Concentrations (CNC) and Sufficiency Ranges (SR) in maize ear leaf at silking or tasseling stage, adopted to assess nutritional deficiencies in maize crop.

References	N (%)	P (%)	K (%)	Zn (mg kg^{-1})	Cu (mg kg^{-1})	Fe (mg kg^{-1})	Mn (mg kg^{-1})
Melsted *et al.,* (1969)[-1]	3.0	0.25	1.9	15	5	15	15
Neubert *et al.*, (1969)[-2]	2.6-4.0	0.25-0.50	1.7-3.0	50 -150	8-20	21-250	34-200
Jones *et al.*, (1990) [-3]	2.8-3.5	0.25-0.40	1.7-2.5	20-114	6-20	21-250	20-150

Table 2. Nutrient deficiencies based on conventional Critical Nutrient Concentration (CNC) in maize crop of selected farmers (150) fields in three districts.

Nutrient	Melsted *et al.* (1969)		Neubert *et al.* (1969)		Jones *et al.* (1990)	
	No. offields deficient	Percent deficiency	No. offields deficient	Percent deficiency	No. offields deficient	Percent deficiency
N	150	100	110	73	146	97
P	18	12	18	12	18	12
K	0	0	0	0	0	0
Zn	10	7	98	65	26	18
Cu	1	1	5	3	1	1
Fe	0	0	0	0	0	1
Mn	0	0	0	0	0	1

Table 3. Mandal wise (30 madals) nutrient deficiencies based on conventional Critical Nutrient Concentration (CNC) in maize crop in three districts.

Nutrient	Melsted *et al.* (1969)		Neubert *et al.* (1969)		Jones *et al.* (1990)	
	No. of mandals deficient	Percent deficiency	No. of mandals deficient	Percent deficiency	No of mandals deficient	Percent deficiency
N	30	100	26	87	30	100
P	2	7	2	7	2	7
K	0	0	0	0	0	0
Zn	1	3	23	77	2	7
Cu	0	0	0	0	0	0
Fe	0	0	0	0	0	0
Mn	0	0	0	0	0	0

Table 4. District wise nutrient deficiencies based on conventional Critical Nutrient Concentration (CNC) in maize crop.

Nutrient	Melsted *et al.* (1969)		Neubert *et al*. (1969)		Jones *et al*. (1990)	
	Districts deficient	Percent deficiency	Districts deficient	Percent deficiency	Districts deficient	Percent deficiency
N	NZB,KNR and WGL	100	NZB,KNR and WGL	100	NZB,KNR and WGL	100
P	Nil	0	Nil	0	Nil	0
K	Nil	0	Nil	0	Nil	0
Zn	Nil	0	NZB,KNR and WGL	100	Nil	0
Cu	Nil	0	Nil	0	Nil	0
Fe	Nil	0	Nil	0	Nil	0
Mn	Nil	0	Nil	0	Nil	0

NZB: Nizamabad KNR: Karimnagar WGL:Warangal

The deficiencies of nutrients identified in maize leaf tissue varied based on different critical levels suggested by different workers.

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