PRIORITIZING THE ORDER OF REQUIREMENT OF NUTRIENT APPLICATION IN SUNFLOWER GENOTYPES USING DRIS INDICES TECHNIQUE

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Abstract: A field experiment was conducted at Acharya N.G. Ranga Agricultural University, Hyderabad (A.P.) India to make an attempt to study and prioritize the order of nutrients requirement in Sunflower. The two genotypes (Morden and KBSH-1) of sunflower with 6 levels of fertilizer application in four replications were studied and orders of nutrient requirement were estimated using DRIS (Diagnosis and Recommendation Integrated System) Indices. The results revealed that, the nitrogen indices for Morden and KBSH-1 were positive at 30 and 45 days of sowing and negative at 60 days after sowing. The trends differed at 75 days after sowing. Morden had a negative index while KBSH-1 was positive. Morden recorded negative indices both for P and K at 30 days after sowing while they were positive at 45 and 75 days after sowing. In the later stages at 60 and 75 days after sowing, the indices for phosphorus were positive but negative for potash. Likewise DRIS indices for secondary and micronutrients were also shown the differed trends. Further, the results of order of requirement also conveyed that, the manganese and iron were the most yield limiting elements both in Morden and KBSH-1 at 30 and 75 days after sowing. Iron and manganese were also serious yield limiting components in Morden and KBSH-1 respectively at 45 days after sowing. Zinc alone was not deficient in both genotypes. Hence, the study suggests that, monitoring of nutrient imbalances through this analogue in estimating the order requirement and correcting nutrient inadequacies on priority will help in sensible utilization of fertilizers and realize high yield levels.

Keywords: DRIS indices, Sunflower, Nutrients.

Introduction: Several methods of fertility management have been proposed from time to time to maintain the soil fertility and improve the crop productivity with different successes. Of late, the close association between the nutrient status of leaves and yield of crop is considered as one of the most important factor. Nutrient indices are worked out in many crops to monitor the adequate and balanced fertilization. The work of [1] indicating that the adequacy of given nutrients or otherwise could be better diagnosed in relation to the level of other nutrients is widely accepted as a Diagnosis and Recommendation Integrated System (DRIS). This method not only helps to identify the nutrient(s) that are deficient but also the order of their severity and requirement is prioritized. This helps the farmer to know which nutrient should be corrected first before attempting to correct the next deficient nutrient through its application. Such an identification of multiple nutrient deficiencies or imbalances is not possible through the conventional methods. Reference [2] stated that this novel technique is a successful nutrient management strategy in different crops. Least information is available on the application of DRIS to identify the multinutrient imbalances in sunflower and fewer publications are available with other crops or tree species in India.

Materials and Methods: The field experiment was conducted at the student's farm at the Agricultural College, Rajendranagar, Hyderabad. The experiment was laid out in RBD (Randomized Block Design) with twelve treatment combinations ie., two sunflower genotypes with six levels of NPK applied (0:0:0; 30:20:10; 60:40:20; 90:60:30; 120:80:40 and 150:100:50 kg NPK/ha). The data recorded from the phenological growth and yield parameters of crop were subjected to 2 x 6 factorial analysis of variance outlined by [3]. The results of physico-chemical analysis revealed that, the soil was sandy loam in texture, low in organic carbon, low in available N (168.9 kg/ha), medium in available P (23.0 kg/ha) and K (249.3 kg/ha). The plant samples collected for dry matter estimation were separated into stalks and leaves at each stage and powdered in an electric grinding machine. The finely ground material was used for chemical analysis. A total of 120 leaf samples drawn each at 30, 45, 60 and 75 days were analysed for N P K Ca Mg S Zn Cu Fe Mn by following standard procedures for each genotype to develop DRIS indices. DRIS norms were established for high yield of ≥ 1300 kg seed yield/ha for Morden and ≥ 1500 kg seed yield/ha for KBSH-1 at different stages of crop growth. DRIS indices worked out to find out the imbalances in the nutrients which limited the seed yield of the two genotypes indicated the order of requirement of nutrients including secondary and micro nutrients from most limiting to those in excess concentrations.

Results and Discussion: Nutrient ratios in the plant tissue of a sampling population are established from sunflower from the corresponding nutrient as norms. Based on these a set of indices are produced denoting a relative sufficiency or deficiency of each element diagnosed. For each diagnosis, the lowest or the most negative DRIS index indicates the most deficient or yield limiting element with respect to the nutrient tested. A DRIS index of zero indicates an element to be present in quantities statistically associated with high yields. Such nutrient imbalances limiting the yield of sunflower from the treatments yielding less than 1300 kg/ha in Morden and 1500 kg/ha in KBSH-1 as determined by the third quartile method. This exercise has been done for nutrient diagnosis at 30, 45, 60 and 75 days after sowing.

The nitrogen indices 0.033, 7.860 and 9.985, 2.894 respectively for Morden and KBSH-1 were recorded positive at 30 and 45 days of sowing and negative at 60 (-8.800 and -8.809) days after sowing. The trends differed at 75 (-4.135 and 4.843) days after sowing. Morden had a negative index while KBSH-1 was positive. The relative requirement of P and K for the two genotypes recorded inconsistent responses at different stages of crop growth. Morden recorded negative indices both for P (-5.011) and K (-0.865) at 30 days after sowing while they were positive (9.387 and 4.533 respectively for P and K) at 45 and 4.345 and 2.640 at 75 days after sowing. The index for phosphorus was positive and negative for potassium at 60 days after sowing. KBSH-1 indicated a reverse trend to that of Morden. The P and K indices were positive (20.776 and 5.790 for P and K respectively) at 30 days but negative (-5.796 and -5.715) at 45 days after sowing. In the later stages at 60 and 75 days after sowing, the indices for phosphorus were positive but negative for potash.

Among the secondary nutrients, the DRIS index for calcium was negative (-0.873) at 30 and -26.360 at 45 days after sowing but positive (15.090) at 60 and 0.083 at 75 days after sowing in Morden. The indices for magnesium were positive during all the stages. The index for sulphur was positive (1.453) at 30 and 3.710 at 75 days after sowing, but, negative (-1.666) at 45 and -4.515 at 60 days after sowing in Morden. In KBSH-1, the indices for calcium were positive during all the stages after sowing. The index for magnesium was negative in the early stage of crop growth (-5.707) at 30 days, however the indices turned positive at 45, 60 and 75 days after sowing. The index for sulphur was positive (2.967) at 30 and 1.173 at 75 days but, negative -0.102 and -10.592 at 45 and at 60 days respectively.

The micro nutrients manganese and iron were most deficient relative to the other nutrients (-13.903 and -169.589) at 30 days after sowing both in Morden and KBSH-1 respectively. Iron and calcium were most deficient followed by copper and sulphur in Morden at 45 days after sowing while manganese followed by phosphorus, potassium, copper and iron were the most yield limiting nutrients in KBSH-1.

The order of requirement revealed that manganese (-13.903 and -160.589) and Iron (-6827 and -56.823) were the most yield limiting elements both in Morden and KBSH-1 at 30 and 75 days after sowing respectively. Iron and manganese were also serious yield limiting components in Morden and KBSH-1 at 45 days after sowing. Zinc alone was not deficient at any stage of crop growth in both the genotypes. The relative order of nutrients required in more quantity than the others are indicated for different stages of crop growth for each of the genotype in table 1.This method has been successfully utilized for several crops [4]. The foliar nutrient status was monitored for winter wheat by [5] and soybean by [6]. Similarly, this technique was suitably applied to fodder crops like alfalfa [7], cash crops like sugarcane [8], potato [9] and horticultural crops like grape wine [10], mango [11] and pomegranate [12]. Reference 13 reported that the DRIS approach to interpreting tissue analysis offers several distinct advantages over the traditional critical nutrient approach.

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Table I Crop growth stage and the order of requirement of nutrient elements at different growth stages of sunflower crop

Growth stage	Days after sowing	Genotype	Order of limitation/Requirement
Vegetative stage	30	Morden	Mn > Fe > Cu > Mg > S > K > N > P > Ca > Zn.
		KBSH-1	Mn > Fe > P > Cu > Ca > K > Mg > N > S > Zn.
Bud stage	45	Morden	Mn > P > K > Cu > Fe > S > Mg > N > Ca > Zn.
		KBSH-1	Fe > Ca > Cu > S > K > P > N > Zn > Mg > Mn.
Flowering stage	60	Morden	S > N > Mn > K > Cu > Fe > P > Mg > Ca > Zn.
		KBSH-1	Mn > Cu > N > S > Fe > K > P > Ca > Zn > Mg
Seed filling stage	75	Morden	Mn > Fe > Cu > Ca > K > S > Mg > P > N > Zn.
		KBSH-1	Mn > Fe > N > Ca > Cu > K > S > P > Mg > Zn.

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