

## Effect of Foliar Nutrition on Growth and Yield of Hybrid Maize (*Zea mays* L.) in Southern Transition Zone of Karnataka

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### ABSTRACT

The field experiment was conducted to study the Effect of foliar nutrition on growth and yield of hybrid maize (*Zea mays* L.) in Southern Transitional Zone of Karnataka at College of Agriculture, Karekere, Hassan, Karnataka. The field experiment was laid out in randomised complete block design with three replications consisting of seven treatments. The soil was red sandy loam with neutral in reaction (pH 6.9) and the electrical conductivity was normal (0.09 dSm<sup>-1</sup>). The available nitrogen content in the soil was Medium (340.5 kg ha<sup>-1</sup>), whereas, the available phosphorus was high (54.3 kg ha<sup>-1</sup>) and low potash (217.5 kg ha<sup>-1</sup>). Plant height differed at harvest. Significantly higher plant height (243.67) was recorded in 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS at harvest (T<sub>8</sub>) compared to recommended (201.3 cm) UAS (B) package (T<sub>9</sub>). The next best treatment was T<sub>7</sub> with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (235.00 cm). Significantly higher leaf area (9166 cm<sup>2</sup> plant<sup>-1</sup>) was noticed in T<sub>8</sub> with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS at 60 DAS compared to recommended UAS (B) package (7165 cm<sup>2</sup> plant<sup>-1</sup>). Yield parameters such as cob weight (214.60 g), cob length (19.43 cm) and number of kernels per row (37.50) were significantly higher with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS (T<sub>8</sub>) which was on par with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (T<sub>7</sub>), 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS (T<sub>4</sub>) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (T<sub>3</sub>).

*Keywords:* Foliar nutrition, Hybrid maize, Macro nutrients

**M**AIZE (*Zea mays* L.) is the world's leading crop and is widely cultivated as cereal grain that was domesticated in Central America. It is one of the most versatile emerging crops having wider adaptability. Globally, maize is known as queen of cereals because of its highest genetic yield potential. Maize is the only food cereal crop that can be grown in diverse seasons and ecologies. Beside this there are many types of maize like normal yellow/ white grain, sweet corn, baby corn, popcorn, waxy corn, high amylase corn, high oil corn, quality protein maize, etc. Apart from this, maize is an important industrial raw material and provides large opportunity for value addition. For increasing the profitability of maize in only economic view, farmers are cultivating the crop intensively with the indiscriminate use of chemical fertilizers, pesticides, weedicides, etc. Maize crop has better yield response to chemical or inorganic fertilizers. Hence heavy doses of these fertilizers are applied to maize. These practices help to increase temporarily the production

of crop. Deterioration of natural resources (*viz.* land, water and air) is also another side of such high input intensive cultivation. Over reliance on use of chemical fertilizers has been associated with decline in soil physical and chemical properties and crop yield. (Hepperly *et al.*, 2009). Further it leads to soil degradation due to over exploitation of land and soil pollution caused by high application rates of fertilizers and pesticide. Foliar nutrition is designed to eliminate the problems like fixation and immobilization of nutrients. Hence, foliar nutrition is being recognized as an important method of fertilization in modern agriculture especially under moisture limited situation. This method provides for utilization of nutrients more efficiently for correcting deficiencies rapidly. Recently, new generation special fertilizers have been introduced exclusively for foliar feeding and fertigation.

Maize growth and yield are adversely affected under nutrients and moisture stress conduction. Foliar

application of major nutrients (NPK) as sole or in combination improves growth, increase yield and yield components of maize under moisture stress condition. Foliar nutrients application not only provides the nutrients to the hungry plants under dryland condition but it also provide water to the thirsty maize plants under drought condition.

#### MATERIAL AND METHODS

A field experiment was conducted in Randomized Block Design which consisted of nine treatments with three replications at College of Agriculture, Hassan, University of Agricultural Sciences, Bangalore during *kharif* 2016. The experimental site is geographically situated in the Southern Transitional Zone (Zone - 7) of Karnataka and located between 12° 13' and 13° 33' N Latitude and 75° 33' and 76° 38' E Longitude at an altitude of 827 m above Mean Sea Level (MSL).

#### Soil of the Experimental Site

The soil was red sandy loam with neutral in reaction (pH 6.9) and the electrical conductivity was normal (0.09 dSm<sup>-1</sup>). The available nitrogen content in the soil was Medium (340.5 kg ha<sup>-1</sup>), whereas the available phosphorus was high (54.3 kg ha<sup>-1</sup>) and low in potash (217.5 kg ha<sup>-1</sup>).

The experiment consisted of nine treatments with three replications laid in RCBD design. The treatments details are as follows.

#### Treatment Details

- T<sub>1</sub> : 75 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS  
 T<sub>2</sub> : 75 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS  
 T<sub>3</sub> : 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS  
 T<sub>4</sub> : 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS  
 T<sub>5</sub> : 75 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS  
 T<sub>6</sub> : 75 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS

T<sub>7</sub> : 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS

T<sub>8</sub> : 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS

T<sub>9</sub> : Recommended UAS(B) package (100:50:25 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O ha<sup>-1</sup>)

**Note:** Recommended FYM (10 t ha<sup>-1</sup>) and ZnSO<sub>4</sub> (10 kg ha<sup>-1</sup>) soil application as per the package of practices is common to all plots. Water soluble macro nutrient 19: 19: 19 (NPK) was sprayed at the rate of 1 per cent concentration.

#### RESULTS AND DISCUSSION

##### Plant Height (cm)

Among all the treatments, 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS registered significantly taller plants (243.67 cm) in T<sub>8</sub> and it was on par with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (235 cm) in T<sub>7</sub>; 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS (234.33 cm) in T<sub>4</sub> and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (233.33 cm) in T<sub>3</sub> compared to other treatments while, lower plant height was recorded with recommended (T<sub>9</sub>) UAS (B) package (201.33cm), as shown in Table 1.

The growth of the plant is the net result of the interplay of diverse metabolic activities taking place in the different parts of the plant during its growth and development in accordance with the supply of light, water, temperature and nutrients from the environment. The plant leaves powered by sunlight, convert simple compounds *viz.*, carbon dioxide and water into carbohydrates and other compounds that are required for growth. The synthesis, accumulation and translocation of these metabolites to the economic part of the plant are often influenced by environmental condition. Previous research has shown that plant height correlates highly with biomass or grain yield, so it is used for estimating biomass (Han *et al.*, 2019) and grain yield (Yin *et al.*, 2011 and Barrero Far fan *et al.*, 2013 and Geipel *et al.*, 2014).

TABLE 1  
Growth parameters as influenced by foliar application of water soluble macronutrients

Treatments	Growth Parameters			
	Plant height at harvest (cm)	No. of green leaves at 60 DAS	SPAD readings at 60DAS	Leaf area at 60 DAS (cm <sup>2</sup> )
T <sub>1</sub> : 75% RDF + 1% water soluble macro nutrient foliar spray at 30 and 45 DAS	207.33	12.93	28.67	7462
T <sub>2</sub> : 75% RDF + 1% water soluble macro nutrient foliar spray at 30, 45 and 60DAS	216.00	13.00	29.80	7637
T <sub>3</sub> : 100% RDF + 1% water soluble macro nutrient foliar spray at 30 and 45 DAS	233.33	13.61	34.20	8619
T <sub>4</sub> : 100% RDF + 1% water soluble macro nutrient foliar spray at 30, 45 and 60DAS	234.33	13.73	34.50	8817
T <sub>5</sub> : 75% RDF + 2% water soluble macro nutrient foliar spray at 30 and 45 DAS	215.67	13.23	31.00	7964
T <sub>6</sub> : 75% RDF + 2% water soluble macro nutrient foliar spray at 30, 45 and 60DAS	221.33	13.40	32.50	8103
T <sub>7</sub> : 100% RDF + 2% water soluble macro nutrient foliar spray at 30 and 45 DAS	235.00	14.61	36.50	9026
T <sub>8</sub> : 100% RDF + 2% water soluble macro nutrient foliar spray at 30, 45 and 60DAS	243.67	14.70	37.60	9166
T <sub>9</sub> : Recommended UAS(B) package (100:50:25 kg N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O ha <sup>-1</sup> )	201.33	12.46	27.50	7165
SE.m±	6.48	0.44	1.35	230
C.D. (P=0.05)	19.43	1.34	3.95	690
C. V. (%)	10.56	9.45	10.56	10

Note: Recommended FYM (10 t ha<sup>-1</sup>) and ZnSO<sub>4</sub> (10 kg ha<sup>-1</sup>) soil application as per POP is common to all plots. Water soluble macronutrient 19 : 19 : 19 (NPK) was sprayed at the rate of 1 per cent and 2 per cent concentration  
DAS: Days after sowing; NS: Non-significant; RDF: Recommended dose of fertilizer

### Number of Green Leaves

At 60 DAS, among the treatments T<sub>8</sub> with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS registered significantly more number of green leaves plant-1 (14.70) (T<sub>8</sub>) and it was on par with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (14.61) (T<sub>7</sub>) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS (13.73) (T<sub>4</sub>) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (13.61) (T<sub>3</sub>) compared to other treatment and lower number of green leaves plant-1 was recorded with recommended UAS(B) package (12.46) (T<sub>9</sub>). Canopy architecture is an

important factor determining yield of many crops as a result of interplant competition for light distribution and absorption, particularly in a dense population. Canopy functions (*e.g.* photosynthesis) improve as leaf area index (LAI) increases until LAI reaches approximately 4 for many maize (*Zea mays* L.) hybrids, but decrease with further LAI increase (Table 1). Similar results were obtained by Drocelle Nirere *et al* (2019).

### Chlorophyll Content (SPAD Readings)

At 60 DAS, among the treatments T<sub>8</sub> with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS registered significantly higher chlorophyll content (37.60 mg g<sup>-1</sup>) and it was on par with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray (T<sub>7</sub>)

at 30 and 45 DAS ( $36.50 \text{ mg g}^{-1}$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray ( $T_4$ ) at 30, 45 and 60 DAS ( $34.50 \text{ mg g}^{-1}$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray ( $T_3$ ) at 30 and 45 DAS ( $34.20 \text{ mg g}^{-1}$ ) compared to other treatment and lower chlorophyll content was recorded with recommended UAS-B package ( $27.50 \text{ mg g}^{-1}$ ) ( $T_9$ ). Chlorophyll has direct roles on photosynthesis and hence closely relates to capacity for photosynthesis, development and yield of crops. With object to explore the role of chlorophyll content and its relation with other yield attributing traits in maize (Bikal Ghimire *et al.*, 2015) and Drocelle Nirere *et al.* (2019) (Table 1).

#### Leaf Area ( $\text{cm}^2$ )

At 60 DAS, among the treatments, 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray ( $T_8$ ) at 30, 45 and 60 DAS registered significantly higher chlorophyll content ( $9166 \text{ cm}^2 \text{ plant}^{-1}$ ) and it was on par with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray ( $T_7$ ) at 30 and 45 DAS ( $9026 \text{ cm}^2 \text{ plant}^{-1}$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray ( $T_4$ ) at 30, 45 and 60 DAS ( $8817 \text{ cm}^2 \text{ plant}^{-1}$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray ( $T_3$ ) at 30 and 45 DAS ( $8619 \text{ cm}^2 \text{ plant}^{-1}$ ) compared to other treatments and lower leaf area was recorded with recommended ( $T_9$ ) UAS (B) package ( $7165 \text{ cm}^2 \text{ plant}^{-1}$ ) (Table 1).

Nitrogen and potassium influence the plant growth in a systematic way and K may contribute to the osmotic potential of the cytoplasm, which is a basic requirement of the osmotic water uptake. Meristematic growth is characterized by the synthesis of proteins and nucleic acid. N is needed for the synthesis of essential macro-materials. All these factors combined together caused increase in dry matter production and its accumulation in fruiting parts (sink) and finally the yield. These results were in concordance with Amanullah *et al.* (2010) and Drocelle Nirere *et al.* (2019).

#### Yield Parameters

##### Cob Weight (g)

Foliar application of water soluble macro nutrient had significant influence on cob weight of maize. Among

the treatments, 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray ( $T_8$ ) at 30, 45 and 60 DAS found significantly superior with respect to cob weight ( $214.60 \text{ g}$ ) as compared to other treatments and it was at par with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray ( $T_7$ ) at 30 and 45 DAS ( $205.60 \text{ g}$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray ( $T_4$ ) at 30, 45 and 60 DAS ( $196.27 \text{ g}$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray ( $T_3$ ) at 30 and 45 DAS ( $188.50 \text{ g}$ ). The recommended UAS-B package ( $T_9$ ) registered significantly lower cob weight ( $166.20 \text{ g}$ ) compared to other treatments (Table 2). These results were in concordance with Drocelle Nirere *et al.* (2019).

##### Cob Length (cm)

Cob length of maize was significantly influenced by foliar application of water soluble macro nutrient. Among the treatments, 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray ( $T_8$ ) at 30, 45 and 60 DAS found significantly superior with respect to cob length ( $19.43 \text{ cm}$ ) as compared to the treatments and it was on par with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray ( $T_7$ ) at 30 and 45 DAS ( $18.03 \text{ cm}$ ), 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray ( $T_4$ ) at 30, 45 and 60 DAS ( $17.13 \text{ cm}$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray ( $T_3$ ) at 30 and 45 DAS ( $16.91 \text{ cm}$ ). The recommended UAS-B package ( $T_9$ ) registered significantly lower cob length ( $13.90 \text{ cm}$ ) (Table 2). These results were in concordance with Drocelle Nirere *et al.* (2019).

##### Cob Diameter (cm)

Foliar application of water soluble macro nutrient had significant influence on cob diameter of maize. Among the treatments, 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray ( $T_8$ ) at 30, 45 and 60 DAS found significantly superior with respect to cob diameter ( $13.41 \text{ cm}$ ) as compared to other treatments and it was at par with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray ( $T_7$ ) at 30 and 45 DAS ( $12.03 \text{ cm}$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar

TABLE 2  
Yield parameters of maize as influenced by foliar application of water soluble macro nutrients

Treatments	Cob weight (g)	Cob length (cm)	Cob diameter (cm)	No. of kernel row cob <sup>-1</sup>	No. of kernel rows <sup>-1</sup>
T <sub>1</sub> : 75% RDF + 1% water soluble macro nutrient foliar spray at 30 and 45 DAS	173.50	14.50	10.56	15.01	31.46
T <sub>2</sub> : 75% RDF + 1% water soluble macro nutrient foliar spray at 30, 45 and 60 DAS	178.90	15.00	10.70	15.40	32.10
T <sub>3</sub> : 100% RDF + 1% water soluble macro nutrient foliar spray at 30 and 45 DAS	188.50	16.91	11.65	16.54	33.50
T <sub>4</sub> : 100% RDF + 1% water soluble macro nutrient foliar spray at 30, 45 and 60 DAS	196.27	17.13	11.90	17.33	34.44
T <sub>5</sub> : 75% RDF + 2% water soluble macro nutrient foliar spray at 30 and 45 DAS	183.17	15.94	10.90	15.90	32.57
T <sub>6</sub> : 75% RDF + 2% water soluble macro nutrient foliar spray at 30, 45 and 60 DAS	186.17	16.01	11.05	16.01	33.20
T <sub>7</sub> : 100% RDF + 2% water soluble macro nutrient foliar spray at 30 and 45 DAS	205.60	18.03	12.03	18.01	35.29
T <sub>8</sub> : 100% RDF + 2% water soluble macro nutrient foliar spray at 30, 45 and 60 DAS	214.60	19.43	13.41	18.37	37.50
T <sub>9</sub> : Recommended UAS(B) package (100:50:25 kg N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O ha <sup>-1</sup> )	166.20	13.90	10.24	14.40	30.34
SE.m±	8.19	0.65	0.39	0.64	1.05
C.D. (P=0.05)	24.57	1.95	1.19	1.93	3.16
C.V.(%)	7.54	11.45	10.68	8.81	9.61

Note: Recommended FYM (10 t ha<sup>-1</sup>) and ZnSO<sub>4</sub> (10 kg ha<sup>-1</sup>) soil application as per POP is common to all plots. Water soluble macronutrient 19: 19 (NPK) was sprayed at the rate of 1 per cent and 2 per cent concentration  
DAS: Days after sowing; NS: Non significant; RDF: Recommended dose of fertilizer

spray (T<sub>4</sub>) at 30, 45 and 60 DAS (11.90 cm) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray (T<sub>3</sub>) at 30 and 45 DAS (11.65 cm). The recommended UAS-B package (T<sub>9</sub>) registered significantly lower cob diameter (10.24 cm) (Table 2).

#### Number of Kernel Rows per Cob

The number of kernel rows per cob in maize was significantly influenced by foliar application of water soluble macro nutrient. Among the treatments, 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray (T<sub>8</sub>) at 30, 45 and 60 DAS recorded significantly more number of kernel rows per cob (18.37) as compared to other treatments and it was at

par with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray (T<sub>4</sub>) at 30 and 45 DAS (18.01) (T<sub>7</sub>) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS (17.33) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray (T<sub>3</sub>) at 30 and 45 DAS (16.54) While recommended UAS (B) package (T<sub>9</sub>) registered significantly lower number of kernel rows per cob (14.40). K fertilizer influences the crude protein contents in grain and amino acids content. K is also involved directly or indirectly in plant protein metabolism. This involvement can begin with the stimulation of NO<sub>3</sub> uptake and transport within the plant (Table 2).

### Number of Kernels per Row

The number of kernels per row in maize varied significantly due to foliar application of water soluble macro nutrient. Among the treatments, 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray ( $T_8$ ) at 30, 45 and 60 DAS recorded significantly more number of kernel per row (37.50) as compared to other treatments and it was at par with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray ( $T_4$ ) at 30 and 45 DAS (35.29) ( $T_7$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS (34.44) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray ( $T_3$ ) at 30 and 45 DAS (33.50). While recommended UAS-B package ( $T_9$ ) registered significantly lower number of kernel per row (30.34) (Table 2).

### Kernel Yield Parameters

#### Kernel Weight per Plant<sup>-1</sup>

The kernel weight per plant in maize varied significantly due to foliar application of water soluble macro nutrient. Among the treatments, 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray ( $T_8$ ) at 30, 45 and 60 DAS recorded significantly higher kernel weight plant<sup>-1</sup> (181.73 g) as compared to other treatments and it was at par with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (176.44 g) ( $T_7$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS (171.56g) ( $T_4$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (169.68 g) ( $T_3$ ). While recommended UAS-B package registered significantly lower kernel weight plant<sup>-1</sup> (129.37g) ( $T_9$ ) (Table 3).

#### 100-Kernel Weight

The 100-kernel weight in maize varied significantly due to foliar application of water soluble macro nutrient. Among the treatments, 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS recorded significantly higher 100-kernel weight (32.20 g) ( $T_8$ ) as compared to other treatments and it was at par with 100 per cent RDF +

2 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (30.30 g) ( $T_7$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS (29.64 g) ( $T_4$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (29.02 g) ( $T_3$ ). While recommended UAS-B package registered significantly lower 100-kernel weight (26.39 g) ( $T_9$ ) (Table 3).

### Kernel Yield

The kernel yield of maize was significantly influenced by foliar application of water soluble macro nutrient. Among the treatments, 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS recorded significantly higher kernel yield (101.50 kg ha<sup>-1</sup>) as ( $T_8$ ) compared to the treatments and it was on par with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (99.11 q ha<sup>-1</sup>) ( $T_7$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS (94.60 q ha<sup>-1</sup>) ( $T_4$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (91.80q ha<sup>-1</sup>) ( $T_3$ ). While recommended UAS-B package registered significantly lower kernel yield (60.63 q ha<sup>-1</sup>) ( $T_9$ ). This increased yield in above treatments were mainly attributed to better availability of plant nutrients as per the crop need, since, foliar nutrition through WSF easily penetrate the leaf cuticle or stomata and enter the cells facilitating easy and rapid utilization of nutrients (Table 3).

### Harvest Index

The harvest index of maize differed significantly due to foliar application of water soluble macro nutrient. The significantly higher harvest index was registered with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS (0.62) ( $T_8$ ) as compared to recommended UAS-B package (0.48) and it was on par with 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (0.61) ( $T_7$ ) and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS (0.61) and 100 per cent RDF + 1

TABLE 3  
Kernel yield parameters of maize as influenced by foliar application of water soluble macro nutrients

Treatments	Kernel weight plant <sup>-1</sup> (g)	100-kernel weight (g)	Kernel yield (q ha <sup>-1</sup> )	Harvest index
T <sub>1</sub> : 75% RDF + 1% water soluble macro nutrient foliar spray at 30 and 45 DAS	139.26	27.45	77.50	0.58
T <sub>2</sub> : 75% RDF + 1% water soluble macro nutrient foliar spray at 30, 45 and 60 DAS	149.46	27.98	81.87	0.59
T <sub>3</sub> : 100% RDF + 1% water soluble macro nutrient foliar spray at 30 and 45 DAS	169.68	29.02	91.80	0.60
T <sub>4</sub> : 100% RDF + 1% water soluble macro nutrient foliar spray at 30, 45 and 60 DAS	171.56	29.64	94.60	0.61
T <sub>5</sub> : 75% RDF + 2% water soluble macro nutrient foliar spray at 30 and 45 DAS	159.46	28.03	83.66	0.57
T <sub>6</sub> : 75% RDF + 2% water soluble macro nutrient foliar spray at 30, 45 and 60 DAS	161.84	28.96	86.66	0.59
T <sub>7</sub> : 100% RDF + 2% water soluble macro nutrient foliar spray at 30 and 45 DAS	176.44	30.30	99.11	0.61
T <sub>8</sub> : 100% RDF + 2% water soluble macro nutrient foliar spray at 30, 45 and 60 DAS	181.13	32.20	101.50	0.62
T <sub>9</sub> : Recommended UAS(B) package (100:50:25 kg N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O ha <sup>-1</sup> )	129.37	26.39	60.63	0.48
SE.m±	5.01	0.84	2.55	0.01
C.D. (P=0.05)	15.02	2.54	7.67	0.05
C. V. (%)	8.53	9.65	10.75	7.73

Note: Recommended FYM (10 t ha<sup>-1</sup>) and ZnSO<sub>4</sub> (10 kg ha<sup>-1</sup>) soil application as per POP is common to all plots. Water soluble macronutrient 19: 19:19 (NPK) was sprayed at the rate of 1 per cent and 2 per cent concentration  
DAS: Days after sowing; NS: Non-significant; RDF: Recommended dose of fertilizer

per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (0.60) (T<sub>3</sub>) and 75 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS (0.59) (T<sub>2</sub>) and 75 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (0.57) (T<sub>5</sub>) and 75 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS (0.59) (T<sub>6</sub>) and 75 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS (0.58) (T<sub>1</sub>) (Table 3). In the present investigation maize kernel yield differed significantly due to foliar feeding of water soluble fertilizers. Among the treatments, soil application of 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS recorded significantly higher kernel yield as compared to other treatments. However, it was on par with 100 per cent RDF + 2 per cent water

soluble macro nutrient foliar spray at 30 and 45 DAS, 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS and 100 per cent RDF + 1 per cent water soluble macro nutrient foliar spray at 30 and 45 DAS. The increased yield in above treatments are mainly attributed to better availability of plant nutrients as per the crop need, since, foliar nutrition through WSF easily penetrate the leaf cuticle or stomata and enter the cells facilitating easy and rapid utilization of nutrients. Combined application of water soluble macro nutrient through foliar spray produced maximum kernel yield in maize as compared to application of individual nutrients only. With respect to frequency of application, foliar application of nutrients at 2 per cent in 30, 45 and 60 DAS at vegetative and reproductive stage found to be better as compared to 30 and 45 at vegetative

stage and 1 per cent in 30, 45 and 60 DAS at vegetative and reproductive stage. The similar findings were also reported by Abd El-Fattah *et al.* (2012) in maize.

From the study it can be concluded that (T<sub>8</sub>): 100 per cent RDF + 2 per cent water soluble macro nutrient foliar spray at 30, 45 and 60 DAS recorded significantly higher growth and yield parameters like plant height, number of green leaves, SPAD values leaf area, Kernal weight, 100 Kernal weight and other yield parameters as compared to other treatments. Same treatment recorded significantly higher grass and net returns compared to other treatments.

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