

## Foliar Spray of Nutrients and Plant Growth Regulators on Nutrient Uptake, Productivity and Economics of Transplanted Finger Millet

A. Sathishkumar\*, N. Sakthivel, E. Subramanian and P. Rajesh

Department of Agronomy, Agricultural College and Research Institute,  
Tamil Nadu Agricultural University, Coimbatore - 641 003

\*Corresponding Author E-mail: [sathishkumar08668@gmail.com](mailto:sathishkumar08668@gmail.com)

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### ABSTRACT

Field experiment was conducted in Eastern block, Department of Farm Management, Tamil Nadu Agricultural University, Coimbatore to study the effect of foliar application of nutrients and plant growth regulators on nutrient uptake, yield and economics of finger millet. The foliar spray treatment comprised of TNAU maize maxim 0.4%, TNAU maize maxim 0.5%, TNAU maize maxim 0.6%, DAP 2%, Boric acid 0.3%, Salicylic acid 40 ppm, Gibberellic acid 50 ppm and Control (no spray). Among the treatments, foliar spray of salicylic acid 40 ppm twice at pre and post flowering stage of crop growth significantly increased the nutrient uptake and yield. Foliar application of salicylic acid 40 ppm twice at pre and post flowering stage of crop growth also recorded higher values of net return (Rs. 41, 211 ha<sup>-1</sup>) and B:C ratio (2.48) ratio compared to other treatments.

**Keywords:** Foliar spray, Economics, Nutrient uptake, Salicylic acid, Yield

### INTRODUCTION

Finger millet is nutritionally comparable and even superior to other cereals especially with respect to protective nutrient. It has eight to ten times more calcium (344 mg /100 g) than wheat and rice and contain a good amount of iron, phosphorous, thiamine and other nutrient, besides high calorific value, the slowly digestible carbohydrates make it a food for long sustenance. Hence, finger millet could play an important role to alleviate malnutrition and to enhance nutritional security that has turned fragile due to excessive dependence on

few major food crops (Rashmi & Seetharam, 2004). The lower productivity of finger millet could be attributed to several factors such as its cultivation in marginal and poor soils, inadequate irrigation and poor management practices. Among these factors, one of the important reasons for poor yield of finger millet is its fertilization aspect. Foliar spray of nutrients and plant growth regulators are fastest way to boost up crop growth because the nutrients are available to plants at the initial stages and critical stages.

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Foliar application of nutrients and growth regulators has been suggested for increasing the fertilizer use efficiency. It provides more rapid utilization of nutrients and permits the correction of observed deficiencies in less time than that would be required by soil treatments. Among the methods of fertilizer application, foliar nutrition is recognized as an important method of fertilization. Since foliar nutrients usually penetrate the leaf cuticle or stomata and enter the cells, it facilitates easy and rapid utilization of nutrients (Latha & Nandanababady, 2003). Foliar nutrition is designed to eliminate the problems of fixation and immobilization of soil applied nutrients. Nutrients applied through foliage would be easily absorbed and translocated in the plant without any loss (Manivannan & Thanunathan, 2003). If foliar nutrition is applied, it reduces the amount of fertilizer which in turn reduces the cost of cultivation thereby economizing the crop production. Prabhakaran and Lourthuraj (2003) suggested that foliar application of fertilizers offers considerable scope not only for better utilization of nutrients but also for the economy of fertilizer application. Keeping these views in mind, the present investigation was carried out to study the effect of foliar spray of nutrients and plant growth regulators on productivity and economics of transplanted finger millet.

#### MATERIALS AND METHODS

Field experiment was conducted during *rabi* 2013-14 in Eastern block, Department of Farm Management, Tamil Nadu Agricultural University, Coimbatore to find out the effect of foliar spray of nutrients and plant growth regulators on growth and yield of irrigated finger millet (*Eleusine coracana* (L.) Gaertn). The soil of the experimental field was sandy clay loam in texture, low in available nitrogen (219.3 kg ha<sup>-1</sup>), medium in available phosphorus (15.2 kg ha<sup>-1</sup>) and high in available potassium (390.7 kg ha<sup>-1</sup>) with pH 8.2 and 0.66% organic carbon. The experiment was conducted on Variety CO 13, comprising of eight treatments *viz.*, T<sub>1</sub> – Maize maxim 0.4% (2 kg ha<sup>-1</sup>), T<sub>2</sub> – Maize maxim 0.5% (2.5

kg ha<sup>-1</sup>), T<sub>3</sub> – Maize maxim 0.6% (3 kg ha<sup>-1</sup>), T<sub>4</sub> – DAP 2% (10 kg ha<sup>-1</sup>), T<sub>5</sub> – Boric acid 0.3% (1.5 kg ha<sup>-1</sup>), T<sub>6</sub> – Salicylic acid 40 ppm (20 g ha<sup>-1</sup>), T<sub>7</sub> – Gibberellic acid 50 ppm (25 g ha<sup>-1</sup>) and T<sub>8</sub> – Control (no spray) was laid out in Randomized Block Design (RBD) replicated thrice. The recommended dose of 60: 30: 30 kg N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O ha<sup>-1</sup> was applied in the form of Urea (46% N), Single super phosphate (16% P<sub>2</sub>O<sub>5</sub>) and Muriate of potash (60 % K<sub>2</sub>O). As per the recommendation, basal application of 30: 30: 30 kg N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O ha<sup>-1</sup> was applied uniformly to all plots at the time of transplanting and the remaining dose of 30 kg N ha<sup>-1</sup> was applied at 45 days after transplanting. Foliar application of nutrients and plant growth regulators was applied twice at pre and post flowering stage of crop growth. Tamil Nadu Agricultural University has developed “Maize Maxim”, a nutrient mixture (major, micro nutrients and growth regulators) to boost maize yield. Keeping this in view, the TNAU maize maxim was also included in the present investigation.

#### RESULTS AND DISCUSSION

##### Nutrient uptake

Nutrient status is an important and deciding factor in judging the total dry matter accumulation in plants. Nutrient uptake thus may minimize the nutrient depletion in the leaves. Due to this, photosynthesis in the leaves will be maintained at a higher level resulting in increased yield. All the foliar spray treatments showed significant variation in the uptake of nitrogen, phosphorus and potassium (Table 1 and 2). Application of salicylic acid 40 ppm twice at pre and post flowering stage of crop growth (T<sub>6</sub>) recorded higher nitrogen (54.6 and 71.5 kg/ha), phosphorus (12.23 and 15.64 kg/ha) and potassium uptake (51.3 and 65.4 kg/ha) at 60 DAT and at harvest, respectively. This was followed by foliar application of gibberellic acid 50 ppm twice (T<sub>7</sub>). The lowest nutrient uptake was recorded with control (T<sub>8</sub>). Foliar application of nutrients and plant growth regulators has shown better effect on nutrient uptake. Foliar spray of salicylic acid at 40 ppm increased the

nutrient uptake of N, P and K which might be due to effective translocation of nutrients from source to sink. Higher concentration of nutrients in seed along with higher seed yield under foliar spray of salicylic acid resulted in higher uptake of nutrients in mungbean (Nafees et al., 2010). This result corroborates the findings of Uma Devi (1998) in sesame and Arjun (2001) in soybean. Sritharan et al. (2005) observed in grain legumes that the application of PGRs and nutrients decrease the leaf senescence by retaining more leaf nitrogen and chlorophyll.

### Grain yield

Spraying of foliar nutrients and growth regulators had significant influence on grain yield of finger millet (Table 2). The plant sprayed with salicylic acid at 40 ppm ( $T_6$ ) produced significantly higher grain yield of 3593 kg ha<sup>-1</sup>. This was followed by foliar application of gibberellic acid at 50 ppm ( $T_7$ ) and this was on par with TNAU maize maxim at 0.6% ( $T_3$ ) with grain yield of 3397 and 3319 kg ha<sup>-1</sup>, respectively. Significantly lower yield of 2709 kg ha<sup>-1</sup> was observed with control ( $T_8$ ). This might be due to enhancement of growth attributing characters like plant height, dry matter production and number of tillers m<sup>-2</sup> and yield attributing characters like number of productive tillers m<sup>-2</sup>, ear head weight and also the nutrient uptake by finger millet. Dawood et al. (2012) observed that increase in kernel yield and yield components of sunflower by salicylic acid were due to the effect of physiological and biochemical processes that led to ameliorate in vegetative growth, active assimilation and translocation from source to sink.

### Straw yield

Application of foliar spray exhibited significant influence on straw yield also (Table 2). Salicylic acid at 40 ppm ( $T_6$ ) recorded the higher straw yield of 8735 kg ha<sup>-1</sup>. The lower straw yield (7436 kg ha<sup>-1</sup>) was recorded with control ( $T_8$ ). The straw yield enhancement due to the adoption of different treatments might be due to continuous supply of nutrients which in turn increased the plant height, dry matter production and number of tillers m<sup>-2</sup> resulting in higher straw yield. This is also attributed due to

the higher nutrient uptake throughout the crop growth period. The results of the present study were in confirmation with the finding of Amin et al. (2008) in straw yield of wheat.

### Economics

The economics such as cost of cultivation, gross return, net return and B:C ratio of finger millet due to foliar application of nutrients and plant growth regulators were calculated and presented in Table 3. Foliar spray was found to alter the gross return, net return and benefit cost ratio. Gross return (Rs. 69, 047/ha) and net return (Rs. 41, 211/ha) were higher with the foliar spray of salicylic acid 40 ppm twice at pre and post flowering stage of crop growth ( $T_6$ ). The next best treatment was the application of gibberellic acid 50 ppm twice at pre and post flowering stage of crop growth ( $T_7$ ), with gross return of Rs. 65, 314/ha and net return of Rs. 34, 519/ha. The control ( $T_8$ ) recorded the lower gross return (Rs. 52, 486/ha) and net return (Rs. 25, 811/ha). With respect to B:C ratio, the foliar application of salicylic acid 40 ppm twice at pre and post flowering stage of crop growth ( $T_6$ ) registered the higher B:C ratio (2.48). The foliar spray of TNAU maize maxim 0.6% twice at pre and post flowering stage of crop growth recorded the next higher B:C ratio (2.20) and the lowest B:C ratio (1.97) was recorded under control ( $T_8$ ). This might be due to the higher yield of finger millet recorded under this treatment and also lower level of cost of cultivation compared to the other treatments. Sujatha (2001) reported that foliar application of salicylic acid improved the B:C ratio in greengram. Similar result was also reported by Arjun (2001) in soybean.

It is evident from the present investigation that, the overall performance of the crop in terms of nutrient uptake, yield and economics were higher with salicylic acid 40 ppm spray twice at pre and post flowering stage of crop growth. The study has clearly indicated that foliar application of salicylic acid 40 ppm twice at pre and post flowering stage of crop growth along with recommended dose of fertilizer would be an ideal practice for getting higher yield and economic returns in finger millet.

**Table 1: Effect of foliar spray on the nitrogen and phosphorus uptake (kg/ha) of finger millet**

Treatment	Nitrogen		Phosphorus	
	60 DAT	Harvest	60 DAT	Harvest
T <sub>1</sub> - TNAU maize maxim 0.4% (2 kg/ha)	47.5	58.5	9.35	11.36
T <sub>2</sub> - TNAU maize maxim 0.5% (2.5 kg/ha)	49.1	62.4	10.25	12.76
T <sub>3</sub> - TNAU maize maxim 0.6% (3 kg/ha)	51.9	67.0	11.00	13.93
T <sub>4</sub> - DAP 2% (10 kg/ha)	47.7	58.9	9.68	11.65
T <sub>5</sub> - Boric acid 0.3% (1.5 kg/ha)	48.4	61.3	10.03	12.45
T <sub>6</sub> - Salicylic acid 40 ppm (20 g/ha)	54.6	71.5	12.23	15.64
T <sub>7</sub> - Gibberellic acid 50 ppm (25 g/ha)	52.3	68.1	11.19	14.20
T <sub>8</sub> - Control (no spray)	44.3	54.7	8.11	9.90
<b>SEd</b>	<b>0.9</b>	<b>1.1</b>	<b>0.39</b>	<b>0.40</b>
<b>CD (p=0.05)</b>	<b>2.8</b>	<b>3.2</b>	<b>0.84</b>	<b>0.86</b>

**Table 2: Effect of foliar spray on the potassium uptake, grain yield, and straw yield (kg/ha) of finger millet**

Treatment	Potassium		Grain yield	Straw yield
	60 DAT	Harvest		
T <sub>1</sub> - TNAU maize maxim 0.4% (2 kg/ha)	44.1	55.5	2945	7760
T <sub>2</sub> - TNAU maize maxim 0.5% (2.5 kg/ha)	47.0	59.7	3200	7996
T <sub>3</sub> - TNAU maize maxim 0.6% (3 kg/ha)	49.3	61.6	3319	8270
T <sub>4</sub> - DAP 2% (10 kg/ha)	44.5	56.5	2977	7826
T <sub>5</sub> - Boric acid 0.3% (1.5 kg/ha)	46.6	58.3	3078	7874
T <sub>6</sub> - Salicylic acid 40 ppm (20 g/ha)	51.3	65.4	3593	8735
T <sub>7</sub> - Gibberellic acid 50 ppm (25 g/ha)	49.8	62.2	3397	8344
T <sub>8</sub> - Control (no spray)	41.7	52.8	2709	7436
<b>SEd</b>	<b>0.6</b>	<b>1.0</b>	<b>87</b>	<b>140</b>
<b>CD (p=0.05)</b>	<b>1.3</b>	<b>2.1</b>	<b>187</b>	<b>300</b>

**Table 3: Effect of foliar spray on the economics of finger millet**

Treatment	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	Benefit cost ratio
T <sub>1</sub> - TNAU maize maxim 0.4% (2 kg/ha)	28615	56892	28277	1.99
T <sub>2</sub> - TNAU maize maxim 0.5% (2.5 kg/ha)	28815	61598	32783	2.14
T <sub>3</sub> - TNAU maize maxim 0.6% (3 kg/ha)	29015	63882	34867	2.20
T <sub>4</sub> - DAP 2% (10 kg/ha)	28315	57497	29182	2.03
T <sub>5</sub> - Boric acid 0.3% (1.5 kg/ha)	28079	59341	31262	2.11
T <sub>6</sub> - Salicylic acid 40 ppm (20 g/ha)	27836	69047	41211	2.48
T <sub>7</sub> - Gibberellic acid 50 ppm (25 g/ha)	30795	65314	34519	2.12
T <sub>8</sub> - Control (no spray)	26675	52486	25811	1.97

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