RESEARCH ARTICLE Agricultural Science Digest, Volume 41 Special Issue: 191-194 (April 2021)

Effect of NPK Water-soluble Fertilizer on Growth, Yield and Nutrient Uptake of Finger Millet

N. Senthilkumar, G. Gokul

10.18805/ag.D-5185

ABSTRACT

Background: The availability of macro and micronutrients added to the soil are affected by soil environmental factors leading to various losses. When a similar amount of fertilizer is applied through foliar application, its use efficiency is increased many folds. In the sandy loam soil, foliar applied fertilizers are up to 20 times more effective as compared to soil applied fertilizers. Water soluble fertilizer of 19:19:19 grade N: P: K is totally water soluble and present in crystalline powder form. It can be applied to the crop by fertigation or through foliar spraying. Instant uptake of nutrients by the plants resulting in significant and quick improvement in crop growth. Humic acid when applied to field converted into readily available humic substances which directly or indirectly effect the plant growth. Foliar application of nutrients along with soil application of nutrients increase the yield and to improve the quality of cereal crops .Keeping the aforesaid facts in consideration, the present investigation was carried out to study effect of NPK water soluble fertilizer on growth, yield and yield attributes and nutrient uptake of ragi.

Methods: The present investigation was carried out during January – May 2018 at farmers field, kamarajapuram village, Katpadi Taluk, Vellore district, Tamil Nadu, India. The experiments were laid out in RBD (Randomized Block Design), Ragi [*Elusine coracana* (L.) Gaertn], CO-14 variety were taken into study. The experimental soil was sandy loam, 10 treatments with replicated thrice. The soil and plant sample was collected periodically proceed with standard analytical and statistical method followed.

Result: Our investigations the soil and foliar feeding of nutrients along with water soluble fertilizer and humic acid combined treatment T_{10} (Soil application of 50% RDN + foliar spray of 50% RDN and 100% P and K through water soluble fertilizer [on 20 and 40 DAT] + foliar spray of humic acid 0.1% [on 20 and 40 DAT]) was significantly superior in performance with respect to growth, yield attributes, quality and nutrient uptake by ragi. It can be recommended to farmers to achieve more benefit from finger millet.

Key words: Growth, Humic acid, Nutrient uptake, Water soluble fertilizer, Yield.

INTRODUCTION

Finger millet [*Elusine coracana* (L.) Gaertn] is one of the important millet crops in India, The cultivated area of ragi in India is 1.02 million ha (m ha) and production is 1.38 million tonnes with an average productivity of 1.4 t ha^{-1}. The major ragi growing states in India are Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, Jharkhand, Maharashtra and Uttaranchal. In Tamil Nadu, ragi is the most important traditional millet crop grown in an area of 0.06 m ha with production of 0.11 million tonnes and the productivity of 1.9 t ha^{-1} that provides food and nutritional security to the marginal farmers in the rain fed dry lands and hilly tribal areas (India Stat, 2017).

The availability of macro and micronutrients added to the soil are affected by soil environmental factors leading to various losses. When a similar amount of fertilizer is applied through foliar application, its use efficiency is increased many folds. In the sandy loam soil, foliar applied fertilizers are up to 20 times more effective as compared to soil applied fertilizers. Arif *et al.* (2006) found that based on soil properties, foliar spraying could be effective 6 to 20 times as compared to soil application. Foliar application could be an advantage for crop growth (Seifi Nadergholi *et al*., 2011). However, acute nutrient deficiencies can often be identified and corrected more rapidly via foliar fertilization than slower-uptake soil amendments (Erica Strauss, 2014).

Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamali University, Annamalai Nagar-608 002, Tamil Nadu, India.

Corresponding Author: N. Senthilkumar, Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamali University, Annamalai Nagar-608 002, Tamil Nadu, India.
Email: senthilkumar.n.au@gmail.com

How to cite this article: Senthilkumar, N. and Gokul, G. (2021). Effect of NPK Water-soluble Fertilizer on Growth, Yield and Nutrient Uptake of Finger Millet. Agricultural Science Digest. 41 (Special Issue): 191-194. DOI: 10.18805/ag.D-5185.

Submitted: 03-04-2020 **Accepted:** 29-08-2020 **Online:** 10-11-2020

Water soluble fertilizer of 19:19:19 grade N:P:K is totally water soluble and present in crystalline powder form. It can be applied to the crop by fertigation or through foliar spraying. Instant uptake of nutrients by the plants resulting in significant and quick improvement in crop growth (SPIC Triumph, 2019). Humic acid when applied to field converted into readily available humic substances which directly or indirectly effect the plant growth (Buyukkeskin and Akinci, 2011).

Addition of humic acid reduces the requirement of primary macronutrients (NPK) at optimal growth (Daur and Bakhashwain, 2013). Application of humic acid along with inorganic fertilizer increases the efficiency of inorganic

fertilizer which in turn aids to reduce its rate without disturbing the yield crop (Han, 2011). Foliar application of nutrients along with soil application of nutrients increase the yield and to improve the quality of cereal crops (Zafar Jamal *et al.,* 2007). Keeping the aforesaid facts in consideration, the present investigation was carried out to study effect of NPK water soluble fertilizer on growth, yield and yield attributes and nutrient uptake of ragi.

MATERIALS AND METHODS

The present investigation was carried out during January – May 2018 at farmers field, kamarajapuram village, Katpadi Taluk, Vellore district, Tamil Nadu, India. The experiments were laid out in RBD (Randomized Block Design), Ragi [*Elusine coracana* (L.) Gaertn], CO-14 variety were taken into study. The experimental soil was sandy loam with a pH of 7.83, EC of 0.26 dSm^{-1} and CEC of 12.50 cmol (p^+) kg^{-1}. The available nitrogen, phosphorus, potassium and sulphur contents were 270.60, 12.57, 256.20 kg ha^{-1} and 13.12 mg kg^{-1} respectively. The experiment consist of ten treatments (T_1- Absolute control, T_2- Soil application of 100% RDF, T_3- Soil application of 50% RDF, T_4- Foliar spray of 100% RDF through water soluble fertilizer (FS on 20 and 40 DAT), T_5- Soil application of 50% RDN + foliar spray of 50% RDN and 100% PandK through water soluble fertilizer (FS on 20 and 40 DAT), T_6- Foliar spray of humic acid 0.1% (FS on 20 and 40 DAT), T_7- T_2 +foliar spray of humic acid 0.1% (FS on 20 and 40 DAT), T_8- T_3 +foliar spray of humic acid 0.1% (FS on 20 and 40 DAT), T_9- T_4 + foliar spray of humic acid 0.1% (FS on 20 and 40 DAT) and T_{10}- T_5 + foliar spray of humic acid 0.1% (FS on 20 and 40 DAT) replicated thrice. Primary tillage was done by disc plough followed by passing cultivator twice, harrowed and levelled to get required seed bed.

The entire dose of N, P_2O_5 and K_2O were applied as basal. Foliar application of water soluble fertilizer and humic acid 0.1 per cent on 20 and 40 DAT was applied as per the treatment. The grain and straw yield were recorded at harvest and analysed for the content of N, P , K and S using the standard procedure.The concentration of nutrients was converted into uptake by multiplying the yield with concentration.

RESULTS AND DISCUSISION

Growth parameters

Significantly higher plant height (122.9 cm), number of tillers (9.4) and dry matter production (12806.5 kg ha^{-1}) at harvest stage were recorded with soil application of 50% RDN + foliar spray of 50% RDN and P and K through water soluble fertilizer (on 20 and 40 DAT) + foliar spray of humic acid 0.1% (on 20 and 40 DAT) (T_{10}) followed by soil application of 50% RDN + foliar spray of 50% RDN and 100% P and K through water soluble fertilizer (on 20 and 40 DAT) (T_5) , T_2, T_9, T_4, T_7, T_8, T_6 and T_3, respectively.

The cumulative and conjective application of soil and foliar feeding of balanced nutrients to the crop might have enjoyed with sufficient nutrient condition for a longer period of time and thereby allowing the plant to perpetuate with plant height. Findings of this investigation are in close conformity with those of Reddy *et al.* (2018), who reported significantly highest plant height in finger millet thropugh 2% urea spray which was at par with 2% 19:19:19 spray. Similar findings were also observed by Rajesh (2011) and Mukund *et al.* (2014) in pigeon pea.

Foliar application of humic acid treatment recorded the highest plant height was obtained from the treatment of leafs (100%) gave a significantly higher plant height than the control and other treatments in common millet (Veysel *et al*., 2011). The findings are in conformity with the work of Define *et al.* (2005) in black gram, Patil *et al.* (2008) in green gram. Han (2011) reported that application of humic acid along with inorganic fertilizer increases the efficiency of inorganic fertilizer which improves the plant growth parameters of crop.

Yield components

The yield parameters like number of fingers, earhead length, number of fingers ear $head^{-1}$ and thousand grain weight, straw yield and grain yield are significantly influenced by soil and foliar application of water soluble fertilizer and humic acid (Table 2). The results indicated significant increase in the number of ear $plant^{-1}$(6.7), earhead length (10.74 cm), number of fingers ear $head^{-1}$ (8.7) thousand grain weight (3.0 gm), straw yield (8206.8 kg ha^{-1}) and grain yield (3376.7 kg ha^{-1}) with soil application of 50% RDN + foliar spray of 50% RDN and P and K through water soluble fertilizer (foliar spray 20 and 40 DAT) + foliar spray of humic acid 0.1% (on 20 and 40 DAT) (T_{10}) over rest of the treatments.

Similar effect of foliar feeding techniques of water soluble fertilizers of plant nutrients on crop production was earlier reported by Srinivasa and Sundari (2004) in black gram, Mallesha *et al.* (2014) in red gram and Das and Jana (2015) in green gram, Rahman *et al.* (2014) in wheat and Reddy *et al.* (2018) in finger millet.

Improved yield and growth attributes might be interpreted as the manifestation of higher nutrients uptake

Table 1: Effect of NPK water soluble fertilizer on plant height, number of tillers $plant^{-1}$ and dry matter production of ragi.

Treatments	Plant height (cm)	Number of tillers $plant^{-1}$	Dry matter production
T_1	58.2	4.1	6424.1
T_2	109.3	8.1	11342.2
T_3	65.5	4.7	7088.6
T_4	94.5	6.9	9887.5
T_5	116.5	8.7	11918.6
T_6	72.6	5.2	7753.9
T_7	87.1	6.3	9212.3
T_8	79.9	5.8	8515.3
T_9	101.7	7.5	10561.7
T_{10}	122.93	9.4	12806.5
CD (P=0.05)	6.32	0.52	663.00

Table 2: Effect of NPK water soluble fertilizer on number of ears plant^{-1}, earhead length, number of fingers ear head^{-1}, thousand grain weight, grain weight, straw yield of ragi.

Treatments	No of ears plant^{-1}	Earhead length (cm)	No of fingers ear head^{-1}	1000 grain weight (gm)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1	2.7	5.26	3.6	2.8	1093.7	3614.9
T_2	5.8	9.46	8.1	2.9	3354.0	7293.3
T_3	3.2	5.85	4.3	2.8	2011.1	4567.2
T_4	4.9	8.22	6.9	2.9	2933.8	6381.2
T_5	6.2	10.09	9.4	3.0	3565.3	7749.8
T_6	3.6	6.43	5.0	2.8	2243.9	5018.4
T_7	4.5	7.62	6.3	2.9	2706.9	5973.9
T_8	4.1	7.02	5.6	2.8	2503.5	5473.9
T_9	5.3	8.83	7.5	2.9	3138.7	6835.4
T_{10}	6.7	10.74	8.7	3.0	3776.7	8206.8
CD (P=0.05)	0.36	0.56	0.57	NS	202.02	423.12

Table 3: Effect of NPK water soluble fertilizer on nitrogen, phosphorus, potassium and sulphur nutrient uptake on ragi.

Treatment details	Nitrogen uptake (kg ha^{-1})		Phosphorus uptake (kg ha^{-1})		Potassium uptake (kg ha^{-1})		Sulphur uptake (kg ha^{-1})	
	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain
T_1 -	10.12	11.16	1.98	3.94	16.27	4.27	2.17	0.87
T_2 -	81.68	51.32	7.59	25.16	70.02	30.25	29.57	14.76
T_3 -	20.55	21.92	2.79	8.25	24.24	9.25	5.02	2.61
T_4 -	57.43	40.49	5.68	18.78	52.96	22.59	19.78	9.68
T_5 -	95.32	57.04	8.60	28.88	81.37	34.94	36.42	17.47
T_6 -	28.1	26.03	3.41	10.55	30.14	12.12	7.53	3.81
T_7 -	46.24	35.46	4.92	15.43	44.46	18.68	14.82	7.31
T_8 -	36.68	31.04	4.16	13.02	37.22	15.27	12.99	5.51
T_9 -	69.04	45.83	6.56	21.97	61.52	26.37	24.61	11.93
T_{10} -	109.97	63.45	9.68	32.10	93.56	39.66	42.68	20.39
CD (p=0.05)	4.56	3.24	0.48	1.92	4.21	1.90	1.71	0.87

by the plants. Nitrogen being a structural component of proteins involved in various biological functions. Whereas, phosphorous involved in better development of root systems and enhance the efficiency of nutrient and water uptake by roots. Potassium imparts resistance to major biotic and abiotic stress.

Nutrient uptake

The Soil application of 50% RDN + foliar spray of 50% RDN and 100% P and K through water soluble fertilizer. (foliar spray 20 and 40 DAT) + foliar spray of humic acid 0.1% (foliar spray 20 and 40 DAT) (T_{10}) recorded significantly higher uptake of N, P and K as compared to other treatments. The treatments receiving soil application of 100 % RDF + foliar spray of WSF at two stages, recorded significantly higher uptake of N, P and K as compare to other treatments. Similar findings were reported by other researchers (Senthil and Kumaresan, 2006; Kalaimani, 2014). Babu (2017) reported that increased dose of RDF along with foliar application of humic acid gradually increased the NPK uptake of black gram. The stimulatory effects of humic substances have been directly correlated with the enhanced uptake of macro nutrients, such as nitrogen, phosphorus and sulphur and micro nutrients such as Fe, Zn, Cu and Mn(Chen *et al.,* 1999). The findings are in conformity with the work of Ayman *et al.* (2009) in bean, Khaled and Fawy (2011) in corn and Du *et al.* (2013) in pearl millet.

CONCLUSION

The soil and foliar feeding of nutrients along with water soluble fertilizer and humic acid combined treatment T_{10} (Soil application of 50% RDN + foliar spray of 50% RDN and 100% P and K through water soluble fertilizer [on 20 and 40 DAT] + foliar spray of humic acid 0.1% [on 20 and 40 DAT]) was significantly superior in performance with respect to growth, yield attributes, quality and nutrient uptake by ragi. It can be recommended to farmers to achieve more benefit from finger millet.

REFERENCES

Arif, M., Chohan, M.A., Ali, S., Gul, R. and Khan, S. (2006). Response of wheat to foliar application of nutrients. J. Agric. Biol. Sci. 1(4). Available online at: http://www.arpnjournals.com. 1106-36.

Ayman, M., El-Ghamry, Kumar, Abd-El-Hai and M. Khalid Ghoneem. (2009). Amino and humic acid promote growth, yield and disease resistance of faba bean cultivated in clayey soil. Aus. J. Basic Applied Sci. 3(2): 731-739.

Babu, S. (2017). Enhancement of black gram productivity through soil and foliar application of nutrients. Proceedings of 71st The IRES Inter. Conf., Kuala Lumpur, Malaysia, 1st - 2nd June 2017.

Buyukkeskin, T. and S. Akinci. (2011). The effects of humic acid on above ground parts of broad bean (*Vicia faba* L.) seedlings under Al^{3+} Toxicity. Fresenius Environ. Bull. 20(3): 539-548.

Chen, Y., Clapp, C.E., Magen, H. and Cline, V.W. (1999). Stimulation of plant growth by humic substances: Effect on iron availability. In: Understanding Humic Substances: Advanced Methods, Properties and Applications. [Ghabbour, E.A., Davies, G. (eds.)]. R. Soc. Chem. Cambridge, UK. 255-263.

Das, S.K. and Jana, K. (2015). Effect of foliar spray of water soluble fertilizer at pre flowering stage on yield of pulses. Agric. Sci. Dig. 35(4): 275-279.

Daur, I. and Bakhashwain, A.A. (2013). Effect of humic acid on growth and quality of maize fodder production. Pak. J. Botany. 45: 21-25.

Define, S., Tognetti, R., Desiderio, E. and Alvino, A. (2005). Effect of foliar application of N and humic acids on growth and yield of durum wheat. Agron. Sustainable Develop. 25: 183-191.

Du, Z.Y., Q.H. Wang, F.C. Liu, H.L. Ma, B.Y. Ma and S.S. Malhi. (2013). Movement of phosphorus in a calcareous soil as affected by humic acid. Pedosphere. 23: 229-235.

Erica Strauss. (2014). Foliar feed vs Soil Amendment- which fertilizer is better? https://www.hobbyfarms.com.

Han, Z.H. (2011). Apple Cultivation with Drawf Rootstock and High Density- theory and Pratice. Science Press, Beijing. http://dx.doi.org.

Indian Stat. (2017). Statistical year book India. www.mospi.gov.in

Kalaimani, P. (2014). Productivity enhancement of greengram through soil and foliar application of nutrients. M.Sc. (Ag.) Thesis, Annamalai Univ., Annamalai Nagar, Tamil Nadu.

Khaled, H. and Fawy, H.A. (2011). Effect of different levels of humic acids on the nutrient content, plant growth and soil properties under conditions of salinity. Soil and Water Res. 6(1): 21-29.

Mallesha, K., Murali and Sanju, H.R. (2014). Effect of foliar application of water soluble fertilizer on yield, nutrient uptake and economics of pigeonpea [*Cajanus cajan* (L.) M.]. Ecol. Environ. Conse. 20(2): 761-764.

Mukund Gowda, K., Halepyati, A.S., Koppalkar, B.G. and Rao, S. (2014). Response of pigeon pea [Cajanas cajan (L.) Millsp.] to application of micronutrients through soil and foliar spray of macronutrients on yield, economics and protein content. Karnataka J. Agric. Sci. 27(4): 460-463.

Patil, S.M., Kaimar, A.V., Patil, H.M. and Gaolwad, C.B. (2008). Response of potash and foliar spray of cow urine on growth and yield of summer greengram (*Vigna radiata* L.). Int. J. Agric. Sci. 4(2): 446-449.

Rahman, M.Z., Islam, M.R., Karim, M.A. and Islam, M.T. (2014). Response of wheat to foliar application of urea fertilizer. J. Sylhet Agril. Univ. 1(1): 39-43.

Rajesh, N. (2011). Studies on the performance of transplanting and foliar nutrition in red gram. *M. Sc. (Ag.), Thesis*, Tamil Nadu Agric. Univ., Coimbatore.

Reddy, B.H., Bulbule, A.V., Gajbhiye, P.N. and Patil, D.S. (2018). Effect of foliar application of plant nutrients on growth and yield of finger millet. Int. J. Curr. Microbiol. App. Sci. 7(3): 2203-2209.

Seifi Nadergholi, M., M. Yarnia and F. Rahimzade Khoei. (2011). Effect of zinc and manganese and their application method on yield and yield components of common bean (*Phaseolus vulgaris* L. CV. Khomein). Middle-East J. Sci. Res. 8(5): 859-865.

Senthil, V.P. and K.R. Kumaresan. (2006). Relative efficiency of controlled release and water soluble fertilizers on the yield and quality of tomato (*Lycopersicon esculentum* Mill.). J. Agron., 5: 519-522.

Sirinivasa perumal, A.P. and Sundari, A. (2004). Response of rice fallow blackgram Cv. ADT 5 to the application of DAP and Phosphobacteria. Legume Res. 27(1): 73-74.

SPIC. (2019). http://spic.in.

Veysel Saruhan, Alpaslan Kurvuran and Sevgibabat. (2011). The effect of different humic acid fertilization on yield and yield components performances of common millet (*Panicum milliaceum* L.). Scientific Res. Essays. 6(3): 663-669.

Zafar Jamal, Muhammad Hamayun, Nadeem Ahmad and Fayyz Chaudhary. (2007). Effects of soil and Foliar application of different concentration of NPK and foliar application of $(NH_4)_2 SO_4$ on different yield paramenters in wheat. J. Agron. 5: 251-256.