International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2020; 8(1): 1718-1721

Received: 09-11-2019
Accepted: 13-12-2019

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Effect of foliar organic nutrients and time of application on seed yield and yield attributes of foxtail millet (*Setaria italica* L.)

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DOI: https://doi.org/10.22271/chemi.2020.v8.i1y.8511

Abstract
A field experiment was carried out to find out the effects of foliar organic nutrient application on seed yield and quality in foxtail millet at Agricultural Research Station, Hanumanmatti, UAS, Dharwad during *Kharif* 2018. The field trial was laid out in Factorial Randomized Block Design. Foliar application of organic nutrients exhibited significant variation on seed yield and yield components of foxtail millet. Foliar application of panchagavya (3%) recorded higher ear head length (20.70 cm), ear head weight (6.49 g), seed yield per plant (5.98 g) and thousand seed weight (4.89 g), seed yield (22.11 q/ha) compared to control. Among the different stage, 50 per cent flowering stage exhibited significantly higher seed yield (21.24 q/ha), ear head length (19.63 cm), ear head weight (6.12 g), seed yield per plant (5.59 g) and thousand seed weight (4.64 g) compared to panicle initiation stage.

Keywords: Foxtail millet, panchagavya, vermiwash, foliar nutrient spray, time of application

Introduction
Millets are the significant food and fodder plants in semi-arid areas and are gaining more importance in a globe that is increasingly becoming populous. Millets are amazing in their nutrient content, each of the millets contains rich in fibres, non-starchy polysaccharides with few unique nutrients and have been recognized as "nutritious or nutritious grains" since they have superior quality proteins and essential amino acids. Among the eight millets, foxtail millet (*Setaria italica* L.) is a dry land crop belonging to the family of graminaceae. It mainly constitutes protein (11.7%), fat (3.9%), ash (3%), crude fiber (7%), carbohydrates (60.9 g), few major micronutrients like Ca (31 mg), Fe (2.8 mg) and amino acids like niacin (3.2 mg), thiamin (0.59 mg) and riboflavin (0.11 mg) (Ahmed *et al*., 2013). This crop has interesting characteristic features *i.e*., fairly tolerant to drought, and can escape terminal drought because of early maturity (Chandra *et al*., 2016) [4]. Foxtail millet is comparable to that of super cereals like rice and wheat due to its capacity to withstand drought, adaptable to adverse climatic condition and input management. It is suitable for intercropping and multiple cropping systems because of its short duration nature and adjustable to mid-season correction. In India, foxtail millet cultivated over an area of 0.619 m. ha with the production of 0.442 mt and productivity of 714 kg per hectare. The area is mostly concentrated in Madhya Pradesh, Andhra Pradesh, Gujarat, Tamil Nadu, Maharashtra and Karnataka. In Karnataka, it is widely grown in Haveri, Dharwad and Belagavi districts of Northern Transitional Zone of Karnataka (Zone-8). It occupies an area of 0.028 m. ha producing 0.01mt with average productivity of 357 kg/ ha (Anon., 2017) [2]. The yield level of this crop is not stable under rainfed conditions due to its cultivation on marginal soils with less inputs use and potential yield are yet to be achieved. The decline in seed yield is mainly because of low soil fertility status and can be maintained on sustainable manner under organic cultivation system. Several strategies have been launched to boost foxtail millet productivity. The efficient way to exploit the potential of the crop by application of organic and inorganic nutrient sources. Among the different method of application *viz*., soil and foliar application is considered as efficient and economical method to supply nutrient requirement at critical stages of crop growth (Chandrasekhar and Bangarusamy, 2003) [5]. As organics are rich in nutrients that help to enhance the physical and chemical properties of soil and improve the use of applied nutrients has led higher seed yield

and its quality. The options available for foliar supplementation of nutrients include use of various organic manures *viz*., FYM, compost, vermin-compost, green manures, bio-fertilizers *etc*., along with other nutrient management practices like use of fermented organics *viz*., panchagavya, jeevamrutha, cow urine and vermiwash *etc*. Application of foliar organic nutrients entails the supply of plant hormones and nutrients in liquid form to plant through aerial parts of the plants *viz*., leaves and stems and other sites to realize enhanced yield and quality (Manonmani and Srimathi, 2016) [10]. The uniqueness of organics is that they provide growth promoting hormones and immunity boosters for plants. (Xu *et al*., 2000; Sreenivasa and Naik, 2011) [13]. The imbalanced use of chemical fertilizers leads to a decline in the crop yield, which results in deficiency of nutrients in the soil. The advantage of liquid organic nutrients is that they disperse in water easily and is rapidly taken up by plants when compared to solid organic fertilizers and interestingly plant can absorb nutrients about twenty times faster through the leaves than applied through the soil, which helps in overcoming temporary, acute nutrient shortages in the crops. Hence, the present investigations entitled "Effect of foliar organic nutrients application on seed yield and quality in foxtail millet (*Setaria italica* L.)" was taken up to study the effect of foliar organic nutrient and time of application on seed yield.

Material and Methods

A field experiment was conducted at Agricultural Research Station, Hanuamanmatti situated in Northern Transition Zone (Zone 8) of Karnataka during *Kharif* 2018 to study the "Effect of foliar organic nutrient application on seed yield and quality of foxtail millet (*Seteria italica* L.)". The freshly harvested DHft-109-3 variety seed materials were taken from the Agriculture Research Station, Hanumanmati which were produced during *kharif* – 2017. The soil of the experimental site is low in available N (170.30 kg/ha) and P_2 O_5 (12.84 kg/ha) and medium in available K_2O (220.37 kg/ha). The experiment was laid out in Factorial Randomized Block Design with three replications. The treatment consisting of two factors where, Factor-1 consists of foliar nutrient application of organic nutrients i.*e*., F_1: Cow urine at 5%, F_2: Panchagavya at 3%, F_3: Vermiwash at 5%, F_4: Jeevamrutha at 5% and F_5: Control (water), whereas, Factor-2 consisted of time of foliar application *i.e*., T_1 at Panicle initiation stage and T_2 at 50 per cent flowering stage. The foxtail millet (DHFt-109-3) was sown with a spacing of 30 cm x 10 cm. The recommended dose of fertilizers (RDF- 30 kg N + 30 kg P_2O_5 + 30 kg K2O ha^{-1}) was applied to the plots as per the treatment details. All the fertilizers were applied in a single dose at the time of sowing as basal dose. The organic foliar sprays of cow urine 5%, panchagavya 3%, vermiwash 5%, jeevamrutha 5% and water spray (absolute contol) were sprayed at two times, one at panicle initiation stage and another at 50 per cent flowering stage according to the treatment combinations and observation were recorded.

Results and Discussion

From the experiment data, higher ear had length (20.70 cm), ear head weight (6.49 g), thousand seed weight (4.89 g), seed yield per plant (5.98 g) and seed yield (22.11 q/ha) was recorded with panchagavya 3 per cent and it was on par with vermiwash 5 per cent (F_3) (19.80 cm, 6.27 g, 4.81 g, 5.72 g and 21.38 q/ha, respectively) compared to control (F_5) (17.13 cm, 5.28 g, 3.73 g, 4.72 g and 19.56 q/ha, respectively) (Table 1). About 13 per cent increase in seed yield per hectare was observed with foliar application of panchagavya over control. The increase in seed yield and yield attributing parameters is mainly due to the presence of plant growth regulating substance present in panchagavya *viz.*, IAA, GA_3. When panchagavya is applied through foliar application it would have created stimuli in the plant system due to higher production of growth regulators and its action in the cell and plant system might have helped in enhancing of biological efficiency of the crop (Yadav and Christopher, 2006) [16]. This might be due to favorable effect of panchagavya on reproductive parts like ear head length, ear head weight, thousand seed weight and seed yield per plants which were regarded as yield attributing parameters. Foliar application helps in slow release of nutrients into leaves and other parts of the plants through the process of absorption. During this process nutrients loss will be low as a result of exchange of cat ion capacity with increased activity of organic content. Thus nutrients will be available for longer time in required quality so that plants can absorb the nutrients as per the requirement, which results in improved growth, development and yield components (Somasundaram, 2003 and Kulkarani, 1991) [12, 9], The maximum enhancement in seed yield with different foliar sources might be due to increased activity of nitrate reductase and supply of essential plant nutrient at required crop growth stage (Jain *et al*., 2014) [8]. These results are in agreement with the findings of Pavan and Hunje (2019) [11] in kabuli chickpea and Sreenivasa and Naik (2011) [13] in wheat, Boomiraj (2003) [3] in bhendi, Somasundaram, (2003) [12] in maize-sunflower-greengram cropping system.

Influence of time of foliar application on growth, seed yield parameters: In the present study, foliar application at 50 per cent flowering stage (T_2) recorded significant increase in yield and yield attributing parameters compared to panicle initiation stage (T_1). From the experiment data, higher ear had length (19.63 cm), ear head weight (6.12 g), thousand seed weight (4.64 g), seed yield per plant (5.59 g) and seed yield (21.24 q/ha) was recorded at 50 per cent flowering stage and compared to panicle initiation stage (T_1) (17.95 cm, 5.71 g, 4.11 g, 5.27 g and 20 q/ha, respectively) (Table 1). About 6.2 per cent increase in seed yield per hectare was noticed due to foliar application at 50 per cent flowering stage compared to panicle initiation stage. Foliar spray during 50 per cent flowering stage might have helped in accumulation of essential nutrients required for grain filling stage which results in better seed yield. Increase in growth, yield and yield attributes might be due to the assimilation of nutrients applied through foliar application at flowering stage which helps the crop to meet the required nutrients demand, because flowering stage of the crop in characterized by more uptake of nutrients for sink development. Foliar application resulted in increased absorption and translocation of nutrients for photosynthetic activity. Foliar application provides easy supply of nutrients and growth stimulants to plants in optimum dose might have reason for increased yield attributes. Choudhary *et al*. (2017) [6, 7] opined that increased availability of nutrients at required growth phase helps in enhancement of carbohydrates synthesis and translocation of photosynthates for development of sink. The pronounced increase in yield might be due to sustained availability of nutrients (N, P, K, S, Zn and Fe) at critical growth phases and also due to increased carbohydrate synthesis and effective translocation of photosynthates to the developing sink resulting in higher yield and yield attributes. Similarly findings were reported by Swaminathan *et al.* (2007) and

Choudhary *et al*. (2014) in groundnut. The interaction effect between foliar organic nutrient spray (F) and Time of application (T) showed non-significant difference for yield parameters.

Table 1: Effect of foliar organic nutrients and time of application on ear head length, ear head weight per plant and test weight in foxtail millet

Treatments	Ear head length (cm)	Ear head weight (g)	Test weight (g)	Seed yield per plant (g)	Seed yield (q/ha)
Foliar nutrient application (F):					
F_1: Cow urine (5%)	17.54	5.42	3.90	5.23	19.88
F_2: Panchagavya (3%)	20.70	6.49	4.89	5.98	22.11
F_3: Vermiwash (5%)	19.80	6.27	4.81	5.72	21.38
F_4: Jeevamrutha (5%)	18.79	6.12	4.55	5.48	20.17
F_5: Control (water)	17.13	5.28	3.73	4.72	19.56
S.Em±	0.61	0.19	0.14	0.17	0.58
C.D at 5%	1.82	0.55	0.41	0.49	1.73
Time of foliar application (T):					
T_1: Panicle initiation stage	17.95	5.71	4.11	5.27	20.00
T_2: 50 per cent flowering stage	19.63	6.12	4.64	5.59	21.24
S. Em±	0.39	0.12	0.09	0.10	0.37
C.D at 5%	1.15	0.35	0.26	0.31	1.10
Interactions (T × F):					
F_1T_1	17.49	5.40	3.81	5.22	19.33
F_1T_2	17.59	5.44	3.99	5.25	20.43
F_2T_1	19.43	6.13	4.46	5.61	20.60
F_2T_2	21.97	6.85	5.33	6.36	23.61
F_3T_1	18.00	5.84	4.35	5.46	21.06
F_3T_2	21.59	6.70	5.28	5.99	21.70
F_4T_1	17.59	5.85	4.23	5.38	19.68
F_4T_2	19.98	6.38	4.88	5.59	20.66
F_5T_1	17.23	5.32	3.72	4.68	19.33
F_5T_2	17.02	5.24	3.75	4.76	19.89
Mean	18.79	5.92	4.38	5.43	20.60
S.Em±	0.87	0.26	0.20	0.23	0.82
C.D at 5%	NS	NS	NS	NS	NS

NS: Non Significant

Conclusion

Foliar application of organic nutrients exhibited significant difference in growth parameter at different stages of the crop. The experiment data revealed that, maximum ear head length (20.70 cm), ear head weight (6.49 g), thousand seed weight (4.89 g), seed yield per plant (5.98 g) and seed yield (22.11 q/ha) were observed due to foliar spray of panchagavya at 3 per cent compared to control (17.13 cm, 5.28 g, 3.73 g, 4.72 g and 19.56 q/ha, respectively) While, foliar application at 50 per cent flowering stage recorded higher ear head length (19.63 cm), ear head weight (6.12 g), thousand seed weight (4.64 g), seed yield per plant (5.59 g) and seed yield (21.24 q/ha) were observed due to foliar spray of panchagavya at 3 per cent compared to control (17.95 cm, 5.71 g, 4.11 g, 5.27 g and 20 q/ha, respectively). From the experiment results it can be concluded that foliar spray of organics helps in achieving higher growth parameters and seed yield parameters. While, foliar spray at 50 per cent flowering stage helps in obtaining higher seed yield parameters.

Acknowledgements

The authors would like to thank Department of Seed Science and Technology and [2]Seed Testing Laboratory, National Seed Project, Seed Unit, UAS, Dharwad for providing facilities to conduct research work.

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