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EFFECT OF FOLIAR FEEDING TECHNIQUE ON GROWTH AND YIELD OF RAGI

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Abstract

The field experiment was conducted during 2018 at Kamarajapuram village, Katpadi Taluk, Vellore district, Tamil Nadu state to find out the effect of foliar feeding technique on growth and yield of ragi (*Elusine coracana* L. Gaertn). The experiment consist of ten treatments which was replicated thrice and in combined with soil and foliar feeding of nutrients along with the water soluble fertilizers and humic acid were taken into study *viz.,* 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 & 100% P&K 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 40DAT), 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). The experiment was laid out in a randomized block design with ten treatments replicated thrice. The results revealed that soil application of 50% RDN + foliar spay of 50% RDN and 100% P and K through water-soluble fertilizer (on 20 and 40 DAT) + foliar application of humic acid 0.1% (on 20 and 40 DAT) (T_{10}) recorded significantly higher growth parameters *viz.,* plant height (122.9 cm), number of tillers plant^{-1} (9.4) and dry matter production (12806.5 kg ha^{-1}) at 90 DAT and yield attributes like number of ear plant^{-1} (6.7), earhead length (10.74 cm), number of fingers earhead^{-1} (8.7), thousand grain weight (3.0 gm), grain yield (3776.7 kg ha^{-1}) and straw yield (8206.8 kg ha^{-1}), recorded with significantly higher values.

Keywords : Foliar spary, water soluble fertilizer, humic acid, growth and yield.

Introduction

Ragi (*Elusine coracana*) (L.) Gaertn) is originally native to the Ethiopian highlands and was introduced into India, approximately 4000 year ago. Ragi is one of the important millet crops in India, next to sorghum and pearl millet. Millets can give signiûcantly higher yields on marginal lands with low fertility and low input agricultural systems compared to many other crops. (Saurav Das *et al*., 2019). It contains 9.2% protein, 1.29% fat, 76.32% carbohydrate, 2.24% minerals and 3.9% ash besides vitamin A and B. The grains are rich in phosphorus, potassium and amino acid. It is also rich source of calcium (410mg 100g^{-1} grain), especially required for growing children and aged people (Tomar *et al*., 2011). The cultivated area of ragi in India is 1.02 million 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 0.61 lakh 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 is applied to the soil, only 10 percent of it is utilized. In the sandy loam, foliar applied fertilizers are up to 20 times more effective when compared to soil applied fertilizers. Foliar feeding is the fertilizer method in which you directly apply a diluted liquid fertilizer to the leaves of the plant. The plant absorbs the nutrients in the fertilizer spray directly through the leaves. Foliar application is a particular technique to supply macro and micro-nutrients which avoids wastage or loss of nutrients which enhances nutrient use efficiency and reduces the cost of cultivation.

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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).

Water soluble fertilizer of N:P:K 19:19:19 which is totally water soluble in crystalline powder form. It contains high quality macro and essential nutrients and chloride free ingredients. This 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 will be seen (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 foliar feeding technique on growth and yield of ragi with following objectives.

Materials and Methods

The present investigation was carried out during January – May 2018, in the 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 exchangeable calcium, magnesium, sodium and potassium contents were 6.20, 3.50, 2.90 and 5.20 cmol (p^+) kg^{-1}, respectively. The experiment consist of ten treatments which was replicated thrice and in combined with soil and foliar feeding of nutrients along with the water soluble fertilizers and humic acid were taken into study *viz.,* 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 & 100% P&K 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 40DAT), 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). Primary tillage was done by disc plough followed by passing cultivator twice, harrowed and levelled to get required seed bed. After the seed bed was prepared, the plots were laid out according to the plan of layout manually.

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 samples were collected at harvest stage analysed for the content of N, P and K using the standard procedure as outlined by Jackson (1973) and uptake were calculated. At harvest grain and straw yield were recorded.

Result and Discussion

Growth parameters

The data on growth parameters like plant height, number of tillers and total dry matter production as influenced by soil and foliar application of water soluble fertilizer and humic acid are presented in table 1. The results indicated that 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 & K through water soluble fertilizer (on 20 and 40 DAT) + foliar spray of humic acid 0.1% (on 20 and 40 DAT) (T_{10}) over all other treatments. This was followed by soil application of 50% RDN + foliar spray of 50% RDN and 100% P & K through water soluble fertilizer (on 20 and 40 DAT) (T_5). The treatments next in order were T_2, T_9, T_4, T_7, T_8, T_6 and T_3, respectively. Whereas, the absolute control (T_1) had the least effect in all other treatments.

This 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 the nutrients uptake thereby allowing the plant to perpetuate with plant height. Findings of this investigation are in close conformity with those of Reddy *et al.,* (2018), reported that in finger millet recorded significantly the highest plant height was recorded by treatment receiving 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

Table 1. Effect of foliar feeding technique 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
S.Ed	**3.01**	**0.25**	**315.57**
CD (P=0.05)	**6.32**	**0.52**	**663.00**
CV	**4.05**	**4.56**	**4.05**

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.

The branches arise from basal nodes of the stem or crown in millets are called as tillers. The rate of production and number of tillers in finger millet are dependent upon nutrient supply. Tillering in millets has considerable capacity to increase the number of tillers per plant under adequate fertilization. The increased tiller production with increased fertilizer may be related to the extra nutrients provided by water soluble fertilizers along with humic acid for the growth of tiller primordial. Higher uptake and recovery of nutrients from the applied nutrients resulted in higher tillering ability of the crop plants (Ragavendra Goud, 2012). Reddy *et al.,* (2018) reported that the highest number of tillers was recorded by the treatment General Recommended Dose of Fertilizer which could be due to better nutrition of crop. The treatment, foliar spray of 2% urea recorded the highest number of followed by 2% spray of 19:19:19 which was on par with each other and significantly superior over all other foliar spray treatments and absolute control. Similar results were observed by Rahman *et al.,* (2014) for wheat where maximum number of tillers was recorded with 2% urea spray. The highest result was obtained when humic acid was applied @ 3 lit ha^{-1} and the lowest was produced at control (Paksoy *et al*., 2010).

Yield components

The data on yield parameters like number of fingers, earhead length, number of fingers ear head^{-1} and thousand grain weight, straw yield and grain yield as significantly influenced by soil and foliar application of water soluble fertilizer and humic acid are presented in table 2. The results indicated that significantly increased 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}), recorded significantly higher values with soil application of 50% RDN + foliar spray of 50% RDN and P & 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}). Where as, absolute control (T_1) had the least effect in all the parameters.

Reddy *et al.,* (2018) reported that in finger millet the different foliar sprays, 2% urea spray has recorded significantly the highest number of fingers finger length and 1000 grain weight however which were at par with 2% 19:19:19 spray. The grain yield was increased by 31.49% due to the application of urea spray followed by 19:19:19 spray which has recorded 30.37% increase in yields. Rahman *et al.,* (2014) has also reported similar results for wheat with 2% urea spray. The highest and lowest harvest index percent were recorded by treatment absolute control and General Recommended Dose of Fertilizer, respectively. 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.

In 2005 and 2006, when the average for over two years was calculated the treatment of humic acid on leafs (100%) gave a significantly higher number of fingers, earhead length, number of fingers ear head^{-1} and thousand grain weight, straw yield and grain yield than the control in common millet (Veysel *et al*., 2011). This

Table 2 : Effect of foliar feeding technique 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
S.Ed	0.17	0.27	0.27	NS	96.16	201.39
CD (P=0.05)	0.36	0.56	0.57	NS	202.02	423.12
CV	4.48	4.12	5.04	-	4.20	4.01

results was in close proximity with the work of Ertan (2007) in black gram and Patil *et al.,* (2008) in green gram. Suriyalakshmi (2013) reported that increased dose of RDF combined with foliar application of humic acid at 25 and 45 DAS excelled all other treatment combinations by recorded higher grain yield and stover yield in blackgram.

Conclusion

Based on the results of the present field experiment, it is concluded that, 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 and quality attributes and found to be effective in nutrient uptake by ragi. It can be recommended to farmers to achieve more benefit out of giving ragi as a poor man crop.

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