Plant Archives Vol. 20 Supplement 1, 2020 pp. 1137-1143 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

ENHANCING CROP GROWTH AND SEED YIELD IN RICE *CV.* ASD16 THROUGH FOLIAR SPRAY

Anand S., R. Pavithra, A. Kamaraj*, P. Satheeshkumar, S. Suganthi and S. Padmavathi

Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar - 608 002 (Tamilnadu) India.

Abstract

A field experiment was conducted with the aim to analyze the effect of various foliar applications *viz.* 2% *Moringa* leaf extract, 2% DAP, 2% Urea, 3% Panchagavya, 1% Boron and 1% Neem leaf extract along with control in rice cv. ASD16 under salinity condition. Observations on growth parameters *viz.,* plant height, leaf length, leaf breadth, days to first flowering, days to 50% flowering, panicle length and yield parameters *viz.,* number of tillers plant^{-1}, number of productive tillers plant^{-1}, number of seed panicle^{-1}, seed L/B ratio, seed yield per plant, dry matter production and 100 seed weight were recorded. The experimental result revealed that foliar application with 1% Boron performed better due to increased crop growth and seed yield in rice *cv.* ASD16 in salinity condition. The resultant seeds from the above treatment registered higher values for the seed quality. Hence, foliar application of 1% boron to rice plants under salinity condition could be recommended to farmers to get better returns.

Key words: Rice, Boron, Foliar, Growth, Moringa leaf extract, Seed yield.

Introduction

Rice is an important staple food crop in Asia. About 90% of the world's rice is grown and consumed in Asia, where 60 percent of the world's population lives. It is estimated that 40% of the world's population uses rice as a major source of energy. White rice is a good source of magnesium, phosphorous, manganese, selenium, iron, folic acid, thiamine and niacin. It is minimal in fibre and its fat content is primarily omega-6 fatty acids, which are considered pro-inflammatory. In India, nearly 70 percent of cultivated land is rainfed but accounts for about 42 percent of the total quantity of produced food grains. In addition to an improved set of practices, a quality seed plays a significant role in increasing the crop productivity. The use of poor quality seeds, soil moisture deficit, low and erratic rainfall and improper crop management are the reason for the low productivity under rainfed condition.

Fertilizer is an important source for improving crop yield in farming methods. Fertilizers affect crop yield and its yield characteristics (Sultana *et al*., 2019). Foliar application of nutrients was more beneficial than soil application, since application rates are lesser as compared to soil application, same results were obtained and the crop reacts to nutrient application immediately (Zayed *et al*., 2011). Foliar nutrition is one of the most important techniques of implementation among fertilizer techniques because foliar nutrients promote nutrients easily and quickly by penetrating stomata or leaf cuticles and entering cells (*Latha and Nadanasasbabady*, 2003). Foliar spray of nutrients at critical growth stages will improve the emergence of panicle and reduce sterility. Due to numerous compensations of foliar application methods like a quick and capable response to needs of plants, more effective, less costly (Inayat *et al*., 2015), less needed products and soil conditions, independence, the application towards foliar fertilizers is arising day by day.

Foliar application of nutrients at proper growth phases is essential for their consumption and improved crop performance (*Anandhakrishnaveni et al.,* 2004). It was found that during crop growth, supplementary foliar fertilization increased plants mineral status and improved crop yields (Femandez *et al.,* 2013; *Rehman et al.,* 2014). Pommerrenig *et al*., 2018 quoted that boron uptake and requirements vary between cultivars and species in distinct phases of growth, soil, crop components. In view

***Author for correspondence :** E-mail : a.kamaraj@yahoo.co.in

of this, the present investigation was carried out to determine the effect of various foliar treatments on crop growth and seed yield in rice *cv.* ASD16 under salinity condition.

Materials and Methods

Genetically and physically pure seeds of rice cv. ASD 16 were obtained from Tamil Nadu Rice Research Institute (TRRI), Aduthurai which formed the basic material for the study. The field evaluation was carried out in the Department of Genetics and Plant Breeding. Faculty of Agriculture and Experimental Farm, Annamalai University, Annamalai Nagar (11^0 24' N latitude and 79^0 44' E longitude with an altitude of + 5.79 feet above sea level) by adopting Randomized Bock Design (RBD) with three replications. The crop was raised with the spacing of 20 × 10 cm and a recommended package of practices for rice was followed. The foliar spray treatments were given to the plants at the time of 30^{th} and 40^{th} days after sowing in the field condition.

Prepared 1% concentration solution was sprayed on rice at three growth stages including tillering stage, booting stage and milking stage by using knapsack sprayer. The following spraying treatments were given as detailed given below:

T_0 - Control
T_2 - 2% Moringa leaf extract
T_2 - 2% DAP
T_3 - 2% Urea
T_4 - 3% Panchagavya
T_5 - 1% Boron
T_6 - 1% Neem leaf extract

Five plants were randomly selected in each of the treatment replication wise and observations on growth and yield parameters *viz.,* plant height, leaf length, leaf breadth, days to first flowering, days to 50% flowering, panicle length, number of productive tillers plant^{-1}, number of productive tillers plant^{-1}, number of seed panicle^{-1}, seed L/B ratio, seed plant yield, dry matter production and 100 seed weight were recorded. The data were analyzed statistically adopting procedure described by *Panse and Sukhatme* (1985). Wherever necessary the values expressed in percentage were transformed into angular (arcsine) values before carrying out the statistical analysis. The critical different per cent (CD) was worked out to 5 (p = 0.05) level and where ‘f values are non-significant, it is denoted by ‘NS’.

Results and Discussion

In crop production, the nutrients have one of the chief importance in improving the quality and productivity of crops which requires mineral nutrients in a large amount. Due to continuous inorganic fertilizers results in micronutrients deficiency, the disproportion in physiochemical properties of soil and that ultimately results in low production of crops. For that reason, these minerals are applied to the affliction foliar form (*Jeyathilake et al*., 2006).

Significant results were obtained in foliar nutrients applied plants. Among the treatments, boron applied plants (T_5) recorded higher values for the growth and yield parameters *viz.* plant height (76.30 cm), days to first flowering (63.40 DAS), days to 50 percent flowering (82.60 DAS), number of tillers plant^{-1} (23.80), number of productive tillers plant^{-1} (13.00), panicle length (24.04), leaf length (32.30 cm), leaf breadth (1.16 cm), number of seeds panicle (146.80), seed L/B ratio (2.59), single plant yield (25.20 g), dry matter production (70.70 g) and 100 seed weight (2.40 g).

Boron (T_5) applied as foliar form in plants recorded higher values for plant height (Fig.1) Nearly 12.87% increase in plant height over the control which could be due to the increasing effect of boron on growth rate and development of root and shoot (*Shah et al*., 2011). This was in accordance with the findings of previous works like *Taiz and Zeiger*, 2006. Boron is reported to be involved in maintaining cell wall structure and maintaining membrane function. It is believed to improve the strength of the membrane and cell wall with the cross-linked polymer and strengthen the vascular bundles which hold back the invasion of pathogens (*Stangoulis and Graham*, 2007). Boron plays an important part in the flowering, and seed-setting process of plants. So, improvement in days to first flowering and days to 50 per cent flowering (63.40 DAS (Fig. 4) and 82.60 DAS (Fig. 5)) may be due to its role in the synthesis of ethylene and also its major role in production and retention of flower buds (*Dell et al*., 2002). Similar findings have been reported by *Huang et al.,* (2000) and *Hussain et al*., (2012).

Boron has been reported to affect plant growth may be due to its role in cell division and expansion. Boron participates in the synthesis of uracil which is involved in RNA formation and promotes cell division and differentiation, thus maintaining the meristematic activity (*Jones*, 2003) and vegetative growth. Increase in leaf length, leaf breadth and panicle length of 9.12%. 11.54% and 9.77% (Fig. 2, 3 and 6) respectively over the control would be due to the stimulated activity of photosynthesis, chloroplast and protein synthesis reported by *Hussain and Yasin* (2004) and *Singh et al.,* (2007).

The number of tillers plant^{-1}, number of productive tillers plant^{-1}, number of seed panicle^{-1}, seed L/B ratio, single plant yield, dry matter production and 100 seed weight which were 20.78%, 35.29%, 13.17%, 3.85%, 16.88%, 10.86% and 12.15% (Fig. 7 to 13) respectively higher than the T_0. Boron applied plants recorded higher values for the number of tillers plant^{-1} (Fig. 7) and productive tillers plant^{-1} (Fig. 8) over the control. This may be due to the B's role in plant reproduction and pollen germination as B progresses pollen in the development of pollen tube (*Bolanos et al.,* 2004). *Ashraf and Foolad* (2005) also pointed out their function in distinguishing and developing cells, translocating photosynthates and growth regulators from source to sink. Similar results were obtained by *Chaturvedi et al.,* (2012) and *Singh et al.,* (2012).

A number of seeds panicle^{-1} (Fig. 9) was more in T_5 than the control was due to the involvement of B in reproductive growth as B improves the panicle fertility in rice (*Rehman et al.,* 2012). Boron is required for pollen tube growth at the time of flower pollination and increased seed set thereby improved the seed yield (Jehangir *et al*., 2017).Besides this, Boron plays an important role in photosynthesis and respiration, carbohydrate metabolism and sugar transport in rice plant (*Rehman et al.,* 2012). Boron nutrition controls the rate of water absorption and metabolism of carbohydrate (*Haque et al.,* 2011). The application of boron enhanced seed set (*Desouky et al.,* 2009; Ali *et al*., 2016) by delaying abscission of flowers. Thus, it is likely that the higher number of flowers per panicle could be due to the sufficient level of carbohydrates available for flower formation (*Smit and*

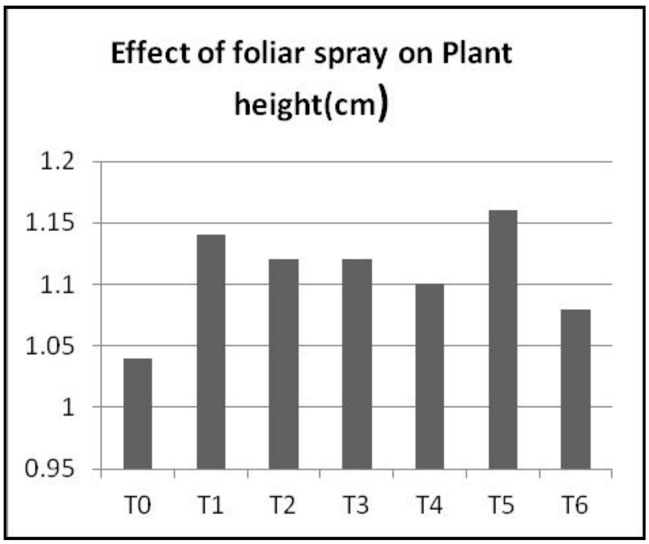
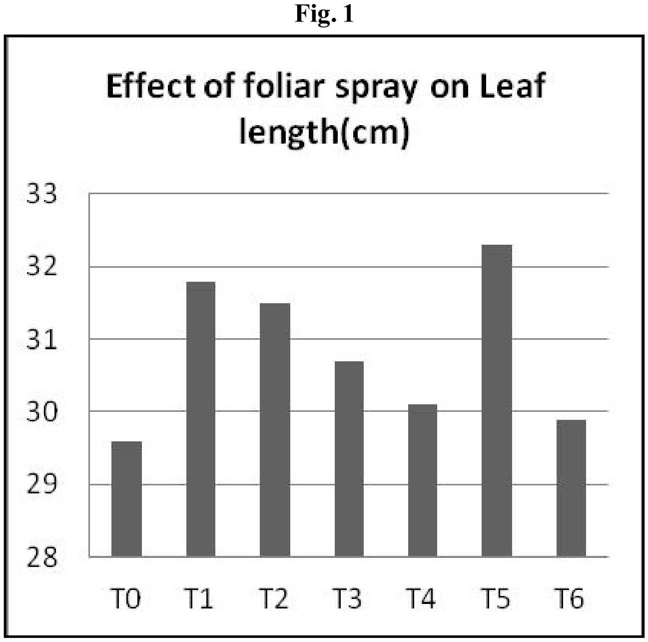


Fig. 1



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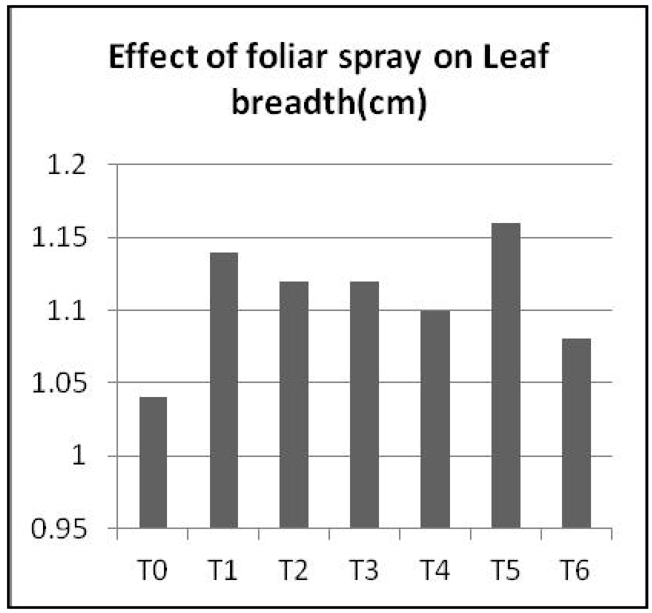

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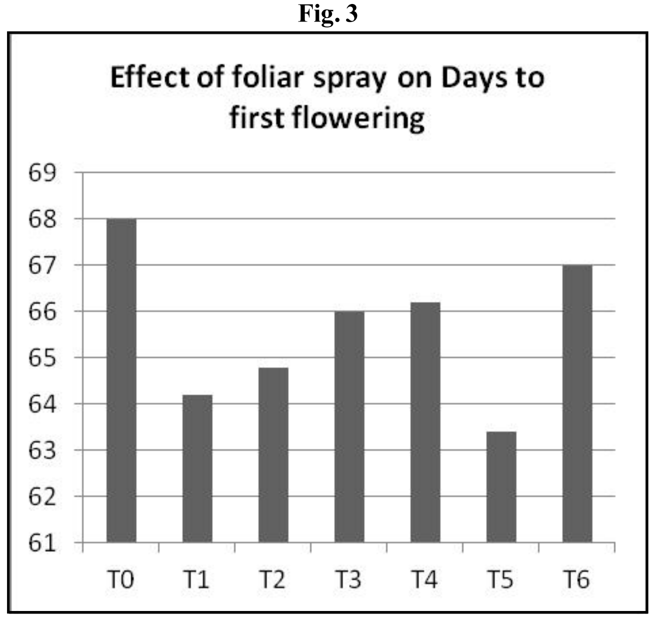


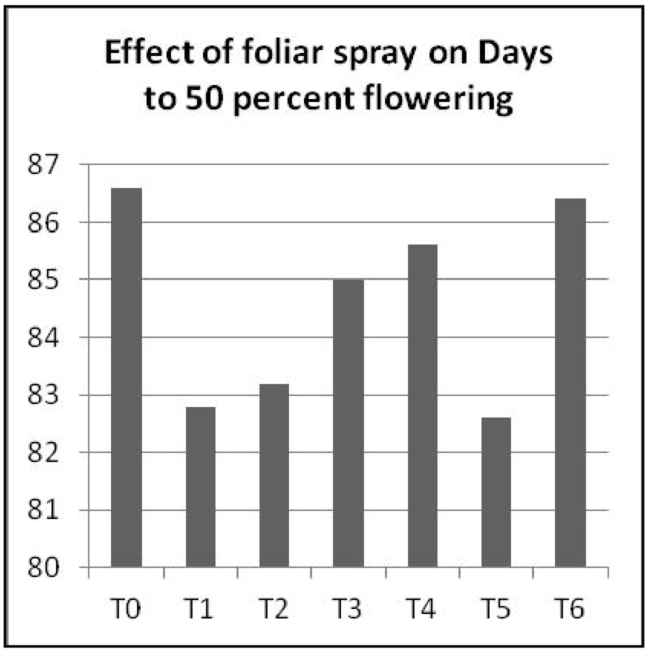
Fig. 4

Combrink, 2004).

Improvement in dry matter production in T_5 might be due to better starch utilization that results in higher seed setting and translocation of assimilates to developing grains, which increases the seed size and number of seeds per panicle (*Hussain et al.,* 2012). Similar results were obtained by *Basher et al.,* (2006) and *Malidareh* (2011). Increase in 100 seed weight (Fig. 13) and single plant yield (Fig. 11) in T_5 may be due to the reduced panicle sterility and less aborted pollen after B application. Boron plays an important part in the fertilization, flowering and seed-setting process of plants, so improvement in seed weight may be due to its role in the production of the more reproductive structure without abortive pollens (Ganapathy *et al*., 2008). This was in accordance with the findings of *Rashid et al.,* (2009); *Hussain et al.,* (2012); *Rehman et al.,* (2014) and Phonglosa *et al*., (2018). Thus, from this present study, 1% boron foliar applied plants showed improved vegetative growth nutrient uptake and yield parameters than control.

In present foliar application treatment, boron foliar applied plants produced seeds recorded higher values for the resultant seed qualities *viz.,* germination percentage (90%), speed of germination (35.80), root length (26.16 cm), shoot length (14.08 cm), seedling length (40.24 cm), dry matter production (0.26 g), vigour index I (3621.60) and vigour index II (23.40) and lower values were recorded in control (Table 1).

Increased seed quality parameters like germination



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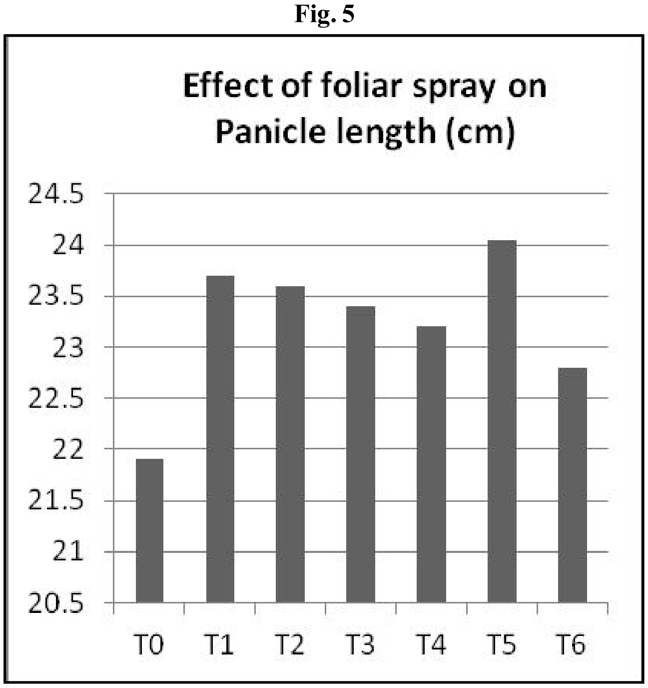

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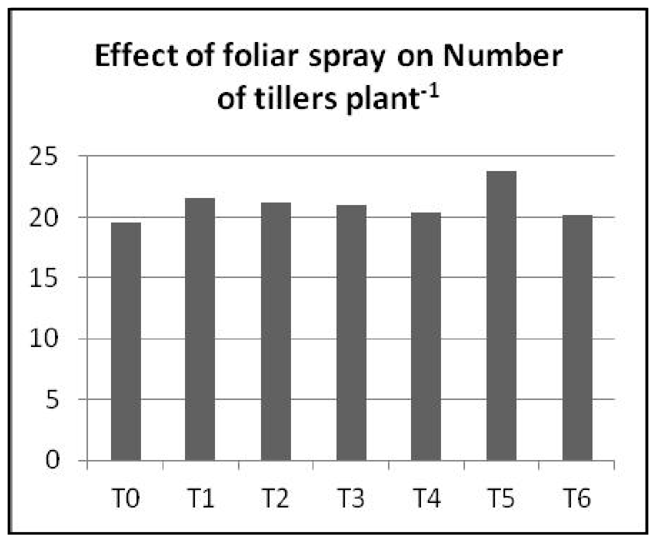

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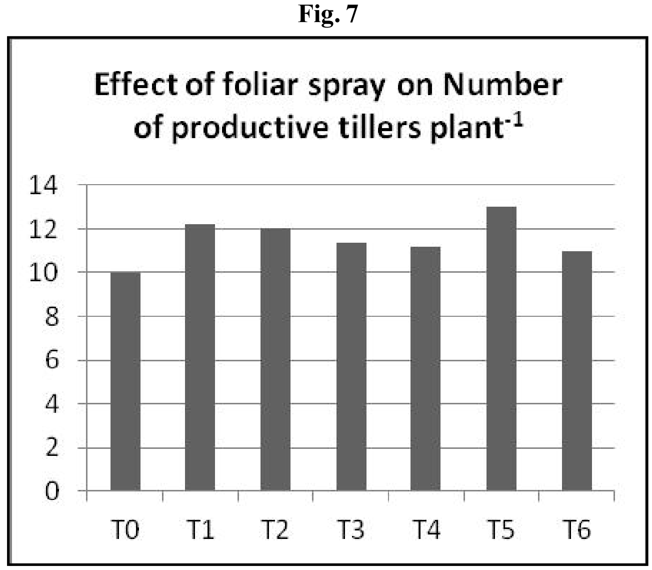

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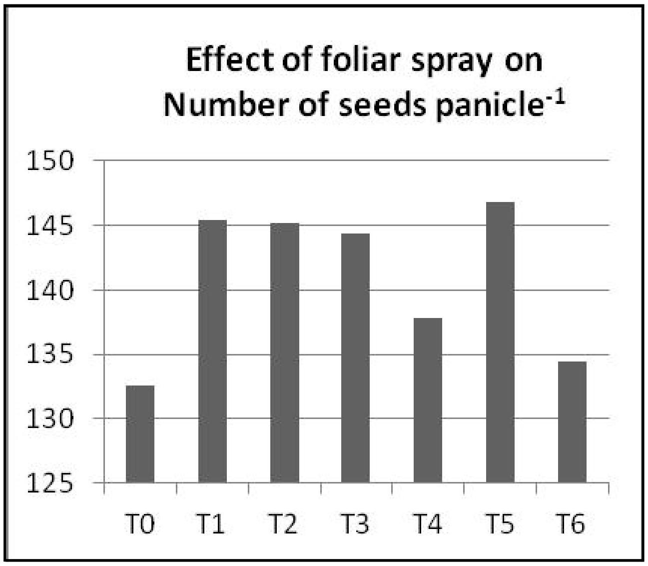
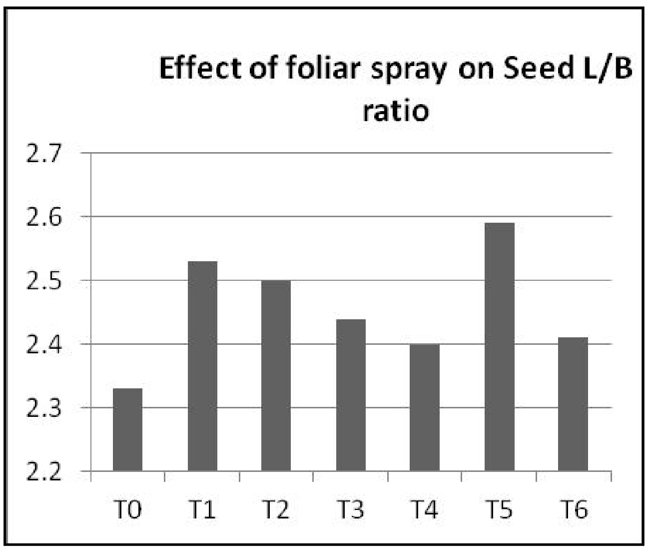


Fig. 9



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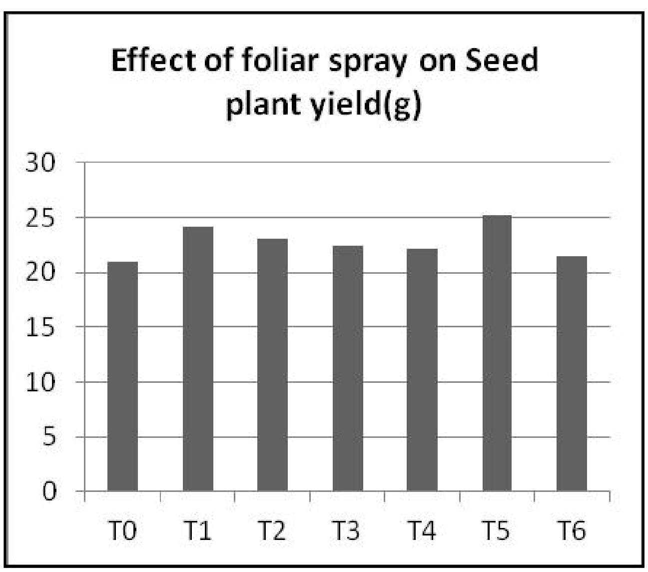

Fig. 11

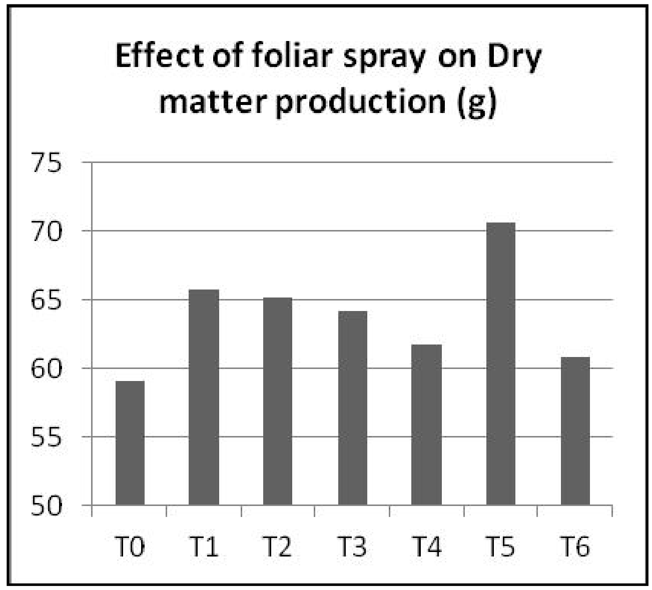

Fig. 12

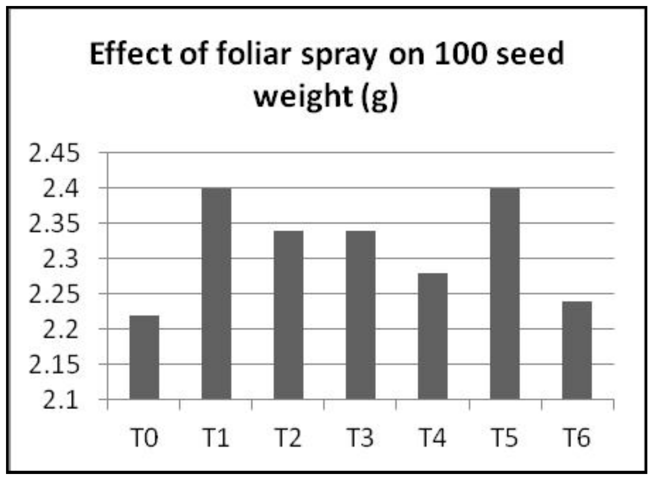

Fig. 13

percentage, speed of germination, shoot length, root length, seedling length, seedling dry weight, vigour index I and vigour index II over control by T_5could be due to synergistic role of Boron in increasing the nutrient availability of calcium and sustaining it over a period of time as compared to their untreated one (Table 1). Similar results were reported by Shah *et al*., (2011).

Further, Hugar and Kurdikeri (2000) have reported that an enhancement in seed quality parameters was due to its better translocation and metabolism of Boron as a carrier of phosphate nutrients particularly into the seed as well as activator of enzymes like transphosphorylase, dehydrogenase and carboxylase, during germination and seedling emergence and also due to the store of more metabolites during seed maturation and improved DNA repair mechanism by increased enzyme activity there by increased the vigour of the seed.

Table 1: Effect of foliar spray on resultant seed quality in rice cv. ASD16.

Treat ment	Speed of Germ -ination	Germin- ation %	Root length (cm)	Shoot length (cm)	Dry matter production (g/10 seedlings)	Vigour Index I	Vigour Index II
T_0	28.35	81(64.16)	21.30	11.16	0.20	2629.26	16.20
T_1	35.76	89(70.64)	25.80	13.82	0.25	3526.18	22.25
T_2	33.41	84(66.42)	25.12	13.52	0.23	3245.76	19.32
T_3	33.22	83(65.65)	24.56	13.44	0.22	3154.00	18.26
T_4	32.69	83(65.65)	23.80	13.34	0.22	3082.62	18.26
T_5	35.80	90(71.56)	26.16	14.08	0.26	3621.60	23.40
T_6	32.39	82(64.90)	23.62	12.82	0.21	2988.08	17.22
Mean	33.09	85(67.00)	24.34	13.17	0.23	3178.21	19.27
SEd	0.0093	0.3257(0.2600)	0.0558	0.0232	0.0022	4.6465	0.4696
CD(P=0.05)	0.0201	0.7002(0.5590)	0.1200	0.0499	0.0047	9.9899	1.0097

Summary

Nutrient foliar sprays to crop plant foliage are usually suggested to correct nutrient deficiencies that arise during the original plant development period. From our current research, Boron @ 1 percent sprayed plants reported greater values for growth parameters *viz.,* plant height (76.30cm), leaf length (32.30cm), leaf breadth (1.16cm), days to first flowering (63.40 days), days to 50 percent flowering (82.60 days) and panicle length (24.04 cm) and seed yield parameters *viz.,* number of tillers plant^{-1} (23.80), number of productive tillers plant^{-1} (13.00), number of seeds panicle^{-1} (146.80), seed L / B ratio (2.59), single plant yield (25.20 g), dry matter production (70.70 g) and 100 seed weight (2.40 g) when compared to other foliar applications and control. The harvested seeds from boron foliar applied plants recorded higher values for the seed qualities *viz.,* germination percentage (90%), speed of germination (35.80), root length (26.16 cm), shoot length (14.08cm), seedling length (40.24cm), dry matter production (0.26g), vigour index I (3621.60) and vigour index II (23.40).

Conclusion

In summary, in comparison with other treatments and control, foliar application of 1 per cent boron is capable of boosting plant growth and seed yield parameters. Boron has a vital role in the formation of proteins, nitrogen, metabolism, cell division, cell membrane integrity, cell wall formation, nucleic acid and antioxidative systems (Goldbach and Wimmer, 2007; Bonilla *et al.,* 2009 and Koshiba *et al.,* 2009). Boron also maintains a stable balance of sugars and starches, pollination and seed production (Gupta *et al.,* 1985). Deficiency or toxicity of boron causes a severe decline in crop yield which is due to an interruption in metabolic events involving boron (*Brown et al.,* 2002). Hence, B is extremely cost-effective micronutrient fertilization (Atique-ur-Rehman *et al*., 2018.).

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