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Effect of foliar application of secondary and micronutrients on quality of potato

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Abstract
The experiment conducted on effect of foliar application of secondary and micronutrients on potato quality was carried out at the Instructional Farm, Faculty of Horticulture of Uttar Banga Krishi Vishwavidyalaya, Pundibari, Cooch Behar during rabi season of 2017-2018. The experiment was laid out in Randomized Block Design with three replications comprising 16 treatments for foliar application of different sole and combined foliar application of secondary and micro nutrients. Result reveled that all the quality parameters were improved significantly. Highest dry matter content in the tubers was 16.81 per cent, Maximum total carbohydrate content of tubers was 46.25, The highest starch content (per cent) of tubers was 18.78, Maximum Reducing and total sugars of tubers were 0.32 and 0.79 was recorded with the foliar application of Magnesium (Mg), sulphur (S), zinc (Zn) and boron (B). But TSS of tubers was not significantly affected.

Keywords: Foliar application, secondary nutrients, micronutrients, potato, quality

Introduction
Potato (*Solanum tuberosum* L.) is the single most popular vegetable-tuber crop grown in more than 150 countries in the world. It belongs to the solanaceae family. Potato is a most important source of inexpensive energy; it provides high levels of carbohydrates, vitamins B, C and minerals also (Muthoni and Nyamongo 2009) [4]. It is quite adaptable to different planting conditions and cultivatable in most parts of the country. Fertilizer application has more effects on the quality and yield of potato. Potato growers apply micronutrient fertilizers including boron (B) for good crop from ancient times. The advantages of foliar application of fertilizer should be explored, such as the smaller amount of fertilizer use, lower cost, ease of application, good quality of fertilizers used for foliar application has potential for an important role in potato production and quality.

Magnesium (Mg) is a major constituent of cell walls and it is vital for the process of photosynthesis and therefore for the life of the plant in general.

Sulphur (S) is now rated as fourth major nutrients after N, P and K and in potato, sulphur is required in many metabolic activities and its deficiency is similar to N in many ways.

Boron (B) is a micronutrient necessary for plant growth. It plays an important roles in cell wall synthesis, sugar transport, cell division, cell development, auxin metabolism, good pollination and fruit set, seed development, synthesis of amino acids and proteins, nodule formation in legumes and regulation of carbohydrate metabolism (Dissoky and Kadar, 2013) [1].

Zinc (Zn) is considered indispensable for the growth of plants. Among different micronutrients, zinc deficiency is more wide spread in the orchard crops and field crops in different parts of India.

An experiment was conducted to study the effect of foliar application of secondary and micronutrients on quality of potato.

Materials and Methods
The present experiment was conducted during *rabi* season of year 2017-18 to study the "effect of foliar application of secondary and micronutrients on quality of potato" at the Horticulture Instructional Farm, Uttar Banga Krishi Viswavidyalaya (U.B.K.V.), Pundibari, Coochbehar. The potato variety Khufri Jyoti used as experimental material and the experiment was laid out in randomized block design with three replicated 16 treatments *viz* T_1:Magnesium; T_2:Sulphur; T_3:Zinc; T_4:Boron; T_5: Magnesium, Sulphur; T_6: Magnesium, Zinc; T_7: Magnesium, Boron; T_8: Sulphur, Zinc; T_9: Sulphur, Boron; T_{10}: Zinc, Boron; T_{11}: Magnesium, Zinc, Sulphur;

T_{12}: Magnesium, Zinc, Boron; T_{13}: Magnesium, Boron, Sulphur; T_{14}: Sulphur, Zinc, Boron; T_{15}: Magnesium, Sulphur, Zinc, Boron; T_{16}: Control (No nutrient). The observations were taken on quality parameters like Dry matter content, Total carbohydrate content, Starch content, Reducing sugar, total sugars and TSS. The dry matter content of tuber was determined by oven drying method. Reducing sugars and total sugars of potato tubers was estimated as per the method suggested by (Ranganna, 1986). Total soluble solids were measured by using of hand refractrometer (0-35 range) and the data was recorded.

Results and Discussion

Dry matter content of tubers (per cent)

Dry matter content of tubers recorded was significantly influenced by the secondary nutrients and micronutrient application as presented in Table 1. Sole application of nutrients showed significant differences and application of Mg recorded highest dry matter content in tubers (14.05%) followed by S (14.01%). Combined foliar spray of Mg, S, Zn and B (T_{15}) significantly increased the dry matter content of tubers (16.81%) over rest of the treatments, and was at par with other treatments like T11. Combined foliar spray of Mg, S, Zn and B (T_{15}) recorded 38.58 per cent increase in dry matter content of tubers over the control.

Total soluble solids (TSS)

There was no significant difference found among various treatments of the foliar application of Secondary and micronutrient application with respect to total soluble solids. The results are presented in Table. However, numerically higher Total soluble solids was observed with treatment T12 (5.47) and lowest total soluble solids was obtained in T_{16} (5.23).

Total carbohydrate content of tubers (per cent)

Total carbohydrate content of tubers recorded was significantly influenced by the Secondary and micronutrient application as presented in Table 1 and fig 1. Sole application of nutrients showed significant differences and application of Mg recorded maximum total carbohydrate content of tubers (35.24%) followed by S (34.48%). Combined foliar spray of Mg, S, Zn and B (T_{15}) significantly increased the total carbohydrate content of tubers (46.25%) over rest of the treatments. Combined foliar spray of Mg, Zn and B (T_{12}) recorded 40.15 per cent increase in total carbohydrate content of tubers over the control. The lowest total carbohydrate content of tubers (33.00%) was recorded in control (T16) and was significantly less than all other secondary and micronutrients.

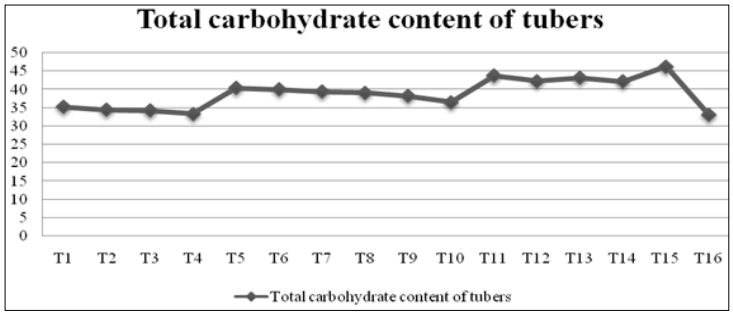

Fig 1: Total carbohydrate content of tubers as affected by foliar application of secondary and micronutrients in potato

Starch content of tubers (per cent)

Table 1 and fig 2 presents the starch content of tubers which was significantly influenced by the secondary and micronutrient application. Application of sole nutrients showed significant differences and application of Mg recorded maximum starch content of tubers (14.46%) followed by S (14.22%). Application of Mg, S, Zn and B (T_{15}) as combined foliar significantly increased the starch content of tubers (18.78%) over rest of the treatments. Combined foliar spray of Mg, S, Zn and B (T_{12}) recorded 45.81 per cent increase in starch content of tubers over the control. Control (T16) recorded the lowest starch content of tubers (12.88%) and was significantly less than all other secondary nutrient and micronutrients application.

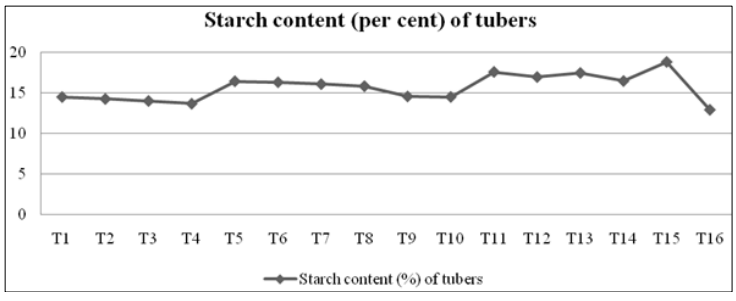

Fig 2: Starch content of tubers as affected by foliar application of secondary and micronutrients in potato

Reducing sugars of tubers

Secondary nutrients and micronutrient application as presented in table 1 and fig 3 significantly influenced reducing sugars of tubers. Sole application of nutrients showed significant differences and application of Mg and S recorded highest reducing sugars of tubers of 0.24% followed combined application of B, Zn 0.23%. Combined foliar spray of Mg, S, Zn and B (T_{15}) significantly increased the reducing sugars of tubers of 0.32% over rest of the treatments. Combined foliar spray of Mg, Zn and B (T_{12}) recorded 68.42 per cent increase in reducing sugars of tubers over the control. The lowest reducing sugars of tubers 0.19% were recorded in control (T16) and were significantly less than all other secondary and micronutrients.

Table 1: Dry matter content of tubers (per cent), total soluble solids, total carbohydrate, starch content, reduced sugar, total sugar of tubers as affected by foliar application of secondary and micronutrients in potato

Treatments	Dry matter content of tubers (per cent)	TSS	Total carbohydrate content of tubers	Starch content (per cent) of tubers	Reducing sugars of tubers	Total sugars of tubers
Mg	14.05	5.33	35.24	14.46	0.24	0.60
S	14.01	5.27	34.48	14.22	0.24	0.59
Zn	13.97	5.37	34.26	13.97	0.23	0.58
B	13.48	5.30	33.36	13.63	0.23	0.57
Mg, S	14.28	5.23	40.36	16.40	0.26	0.63
Mg, Zn	14.27	5.47	39.98	16.28	0.26	0.62
Mg, B	14.24	5.27	39.42	16.05	0.25	0.62
S, Zn	14.23	5.27	39.13	15.79	0.25	0.61
S, B	14.17	5.37	38.22	14.53	0.25	0.6
Zn, B	14.07	5.37	36.51	14.47	0.24	0.6
Mg, Zn, S	15.16	5.40	43.72	17.55	0.28	0.67
Mg, Zn, B	14.72	5.47	42.27	16.92	0.26	0.65
Mg, B, S	14.91	5.37	43.18	17.42	0.27	0.67
S, Zn, B	14.31	5.40	42.16	16.43	0.26	0.65
Mg, S, Zn, B	16.81	5.30	46.25	18.78	0.32	0.79
Control	12.13	5.23	33.00	12.88	0.19	0.54
SE (m)	0.37	0.07	0.27	0.05	0.01	0.03
SE (d)	0.53	0.10	0.39	0.07	0.01	0.04
CD(0.05)	1.08	N.S	0.80	0.14	0.02	0.08
CV (%)	4.50	2.18	1.22	0.52	5.42	7.59

Total sugars of tubers

Total sugars of tubers recorded were significantly influenced by the Secondary and micronutrient application as presented in Table 1 and fig 3. Sole application of nutrients showed significant differences and application of Mg recorded maximum total sugar of tubers of 0.60 per cent followed by S of 0.59 per cent. Combined foliar spray of Mg, S, Zn and B (T_{15}) significantly increased the total sugar of tubers of 0.79 per cent over rest of the treatments. Combined foliar spray of Mg, Zn and B (T_{12}) recorded 46.30 per cent increase in total sugar of tubers over the control. The lowest total sugar of tubers of 0.54 per cent was recorded in control (T16) and was significantly less than all other secondary and micronutrients.

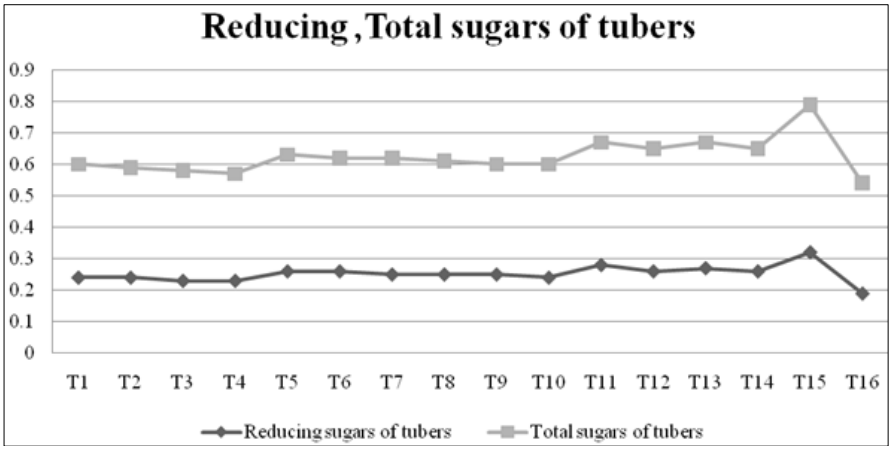

Fig 3: Reducing sugar, total sugars of tubers as affected by foliar application of secondary and micronutrients in potato

Discussion

The increase in quality of tubers in terms of TSS, starch, total CHO, sugars, texture, dry matter, storage life of tubers in the plant is due to presence of secondary nutrients and micronutrient which have positive effect on potato tuber storage and quality. They ensure a strong photosynthetic capacity and enzyme activity. Metabolism of carbohydrate increases qualitative and quantitative performance of potato tubers. The biochemical and physiological plant processes, including photosynthetic carbon dioxide fixation, protein synthesis, chlorophyll formation, partitioning and utilization of photo assimilates, photophosphorylation (including ATP formation in chloroplasts), loading of sucrose in the phloem, photo-oxidation in leaf tissues, improves and increases quality and storage. These results are in good accordance with those obtained by Klikocka (2009) [3], Dissoky and Kadar (2013) [1], Panitnok *et al.* (2013) [5], Parmar *et al.* (2016) [6] and Javanmardi and Rasuli (2017) [2].

Conclusion

From this experiment it can be concluded that growing of potato with combined foliar spray of magnesium, sulphur, zinc, and boron (T_{15}) is the most effective among the various secondary and micronutrients treatments as it influences the crop throughout its growth with the resultant increase in quality parameters. Thus, it can be concluded that combined foliar spray of four nutrients *viz.*, Mg, S, Zn, and B are most effective in recording maximum dry matter content, total CHO, starch content and sugars of tubers. So, these secondary nutrients and micronutrients (Mg, S, Zn, and B) along with normal doses of major nutrients may be recommended to the potato growers to get higher growth and yields, to prevent

loss and to increase the overall production of potato in terai agro-climatic region of West Bengal.

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