

Effect of micronutrient zinc and boron on the aphid incidence of potato

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Abstract

Bio-efficacy of various treatment schedules of micronutrient Zinc (Zn) and Boron (B), viz T₁ (V₂Zn₀B₀), T₂ (V₂Zn₁B₁), T₃ (V₂Zn₁B₀), T₄ (V₂Zn₀B₁), T₅ (V₁Zn₀B₀), T₆ (V₁Zn₁B₁), T₇ (V₁Zn₁B₀) and T₈ (V₁Zn₀B₁) were evaluated against aphid, *Myzus persicae* (Sulzer) (Aphididae: Hemiptera) in two potato variety, Kufri Chandramukhi (K.CM) and Kufri Jyoti (K.JT) during Rabi season of two consecutive years in 2017-2018 and 2018-2019 from November to February. The application in combination of both zinc and boron was most effective in reducing the population of aphid in both the cultivars of potato i.e. Kufri Chandramukhi and Kufri Jyoti. Therefore the cultivar Kufri Jyoti (T₂) and Kufri Chandramukhi (T₆), were recorded lower aphid infestation. The percentage of healthy tuber yield of K.JT and K.CM was found highest in T₆ (81.43 – 82.47%) and T₂ (78.93 – 80.75%) and found lowest in T₅ (63.24 – 68.58%) and T₁ (66.45 – 69.49%), respectively. Similarly percentage of tuber damage of K.JT and K.CM was noted highest in T₅ (31.42 – 36.76%) and T₁ (30.51 – 33.55 %) and it was lowest in T₆ (17.53 – 18.57%) and T₂ (19.25–21.07%), respectively. Among the different treatment schedules combined application of Zn and B in T₂ and T₆ revealed effective result in increasing marketable yield of potato tubers and reduction of aphid incidence over control T₁ and T₅ and also over other treatments.

Keywords: aphid, effectiveness, micronutrients, potato, yield

Introduction

Potato (*Solanum tuberosum* L.) plays an important role along with other essential vegetables in our daily diet. It grows all over the country under a wide range of agro-climatic conditions and secures third and fourth rank in the world (Pandey *et al.* 2007) [8] in the area (2.16 m ha) and production (53.04 mt), respectively, with the productivity of 24.56 t ha⁻¹ (Indian Horticulture Database, 2019) [5]. Varietal limitation along with pest and disease infestations are the major constrains for achieving higher production of potato. Near about 100 insect pests and non-insect pests all over the world were recorded to infest potato crop and of which the aphid namely *Myzus persicae* (Sulzer) (Aphididae: Hemiptera) found to be the most important sucking pest that not only causes damage by sucking plant sap, but also transmitting various potato viruses (Konar *et al.* 2003, Konar and Paul, 2005, Dharpure, 2002 and Bhatnagar, 2007) [7, 6, 3, 2] as a result yield of potato tubers being reduced. To minimize the crop loss by this pest the growers use pesticides not only as control tactics. As a result, the chances of health hazards are increased as in many cases potato is used just after little boiling. The knowledge in this line ultimately helps to formulate effective management strategies against the noxious sucking pests of potato and this was the major reason to focus the present study in this area of research. Therefore, keeping in view, the present investigation was conducted to assess the efficacy of different treatment schedules against aphid of potato. A thorough study regarding the incidence pattern of aphid and effect of various micronutrients on the occurrence of the insect pests are very much essential to control these pests effectively.

Sometimes excess application of micronutrients increase the Incidence of pest and diseases and make the crop susceptible to pest and diseases. Therefore the present investigation was undertaken to study the incidence pattern of aphid of potato in new alluvial zones of West Bengal with the role of micronutrient (Zn and B) application on the occurrence of aphid of Kufri Jyoti and Kufri Chandramukhi varieties of potato. Apart from this field trial efforts were also being made to work out the most effective way to controlling these pests with a view of safer human toxicity.

Materials and Methods

The present field (Fig. 1) study was laid down to find out the effect of zinc and boron on the aphid incidence of potato-pest complex for two consecutive Rabi seasons from November to February during 2017-18 and 2018-19 respectively at District Seed Farm, Department of Agriculture, Government of West Bengal, P.O. - Burdwan, Dist.-Burdwan and West Bengal. The effect of micronutrients (Zn and B) on the incidence of aphid (Fig. 2) on potato was evaluated for two years (2017-18 and 2018-19). The experiment was carried out in 2-factor RBD with three replications (Gomez and Gomez, 1984) [4]. All standard agronomic practices, recommended for the state, were strictly followed during raising the crop (Anonymous, 2015) [1] Kufri Jyoti and Kufri Chandramukhi were sown in 6x2 sq. m. Plot with a spacing of 60 x 20 cm. The recommended agronomic practices were followed without any application of plant protection chemical for growing the crop.

There were eight treatments with different dose of Zn and B in both the varieties (Table 1).



Fig 1: RBD in the experiment field



Fig 2: Aphid (nymph) infestation on potato leaf

Table 1: Different treatments of Zn and B applied in the experiment

Number of treatments	Treatments	Quantity of Zn and B
1	T ₁ (V ₂ Zn ₀ B ₀)	0 kg Zn + 0 kg B/ha on V ₂
2	T ₂ (V ₂ Zn ₁ B ₁)	5 kg Zn + 5 kg B/ha on V ₂
3	T ₃ (V ₂ Zn ₁ B ₀)	5 kg Zn + 0 kg B/ha on V ₂
4	T ₄ (V ₂ Zn ₀ B ₁)	0 kg Zn + 5 kg B/ha on V ₂
5	T ₅ (V ₁ Zn ₀ B ₀)	0 kg Zn + 0 kg B/ha on V ₁
6	T ₆ (V ₁ Zn ₁ B ₁)	5 kg Zn + 5 kg B/ha on V ₁
7	T ₇ (V ₁ Zn ₁ B ₀)	5 kg Zn + 0 kg B/ha on V ₁
8	T ₈ (V ₁ Zn ₀ B ₁)	0 kg Zn + 5 kg B/ha on V ₁

V₁= Kufri Chandramukhi; V₂= Kufri Jyoti

The population dynamics of aphid were recorded at 7 days interval after germination of potato till harvesting of the crop. The observations on aphid population was done on 100-leaf index method (Simpson, 1940). The pest population in a plant was recorded from one upper, one middle and one lower compound leaf. Following this method, of 10 plants were selected at random in each plot. Besides this, the yield of healthy and damaged tubers in the field was also noted down during harvesting. The data recorded were subjected to necessary transformations before proceeding to any statistical analysis.

Result and Discussion

Eight micronutrient treatments consisting of Zinc (Zn) and Boron (B) were evaluated against aphid incidence on Kufri Jyoti and Kufri Chandramukhi varieties of potato in two consecutive years during 2017-18 and 2018-19. The pooled data of two years revealed that the potato treated with

different treatments of Zn and B reduced the number of aphid significantly over untreated control in both the varieties of potato (Kufri Chandramukhi and Kufri Jyoti) (Table 2). It showed that T₂ (B₁Zn₁) recorded the lowest mean aphid population (5.90) as against the highest mean population of aphid (13.00) in untreated control (T₁) in case of Kufri Jyoti. It was closely followed by T₄ (B₁Zn₀) and T₃ (B₀Zn₁) recording the population of (6.61 and 9.59) respectively. But in case of Kufri Chandramukhi T₆ (B₁Zn₁) gave maximum decrease of aphid population (5.61) over control (T₅) recording the highest mean population of 15.82 and then in the order were T₇ (6.15) and T₈ (10.08). The lowest population of aphids in both the varieties Kufri Jyoti and Kufri Chandramukhi was found in T₂ (B₁Zn₁) and T₆ (B₁Zn₁) with a minimum mean population of 5.90 and 5.61 respectively. These treatments (T₂ and T₆) were found effective to some extent in reducing the incidence of aphid population in both the varieties of potato as compared to other treatments including control. Micro nutrient alone in (B₀Zn₁ and B₁Zn₀) in T₃, T₄, T₇ and T₈ treatments cannot manage the infestation of aphids on both the varieties of potato throughout crop growing season below its critical limit. From the results it is evident that the combine application of both zinc and boron showed best result in minimizing the aphid population in both the varieties of potato Kufri Chandramukhi and Kufri Jyoti against the other treatments. On the other hand, single application of boron recorded minimum population of aphid in Kufri Jyoti in comparison to single application of zinc while single application of zinc gave better result in minimizing the population of aphid in Kufri Chandramukhi. The yield of potato tuber was also mainly depends on the infestation level of aphid. Therefore the yield of potato tubers on different treatments was evaluated during harvesting of the crop. In the first year of study (2017-18), it has been observed that yield of the crop varied significantly with different treatments (Table 3). The weight of healthy tuber per plot was obtained maximum in T₂ (27.50 t ha⁻¹) which was succeeded by T₄ (26.20 t ha⁻¹) and T₃ (25.67 t ha⁻¹) over T₁ (20.10 t ha⁻¹), respectively in the potato variety of K.JT. Similar performance by Zn and B was also observed in K.CM recording highest yield of healthy tubers in T₆ (26.20 t ha⁻¹) followed by T₈ (24.00 t ha⁻¹) and T₇ (23.20 t ha⁻¹) than control in T₅ (18.90 t ha⁻¹), respectively. Added to this T₂ gave highest percentage of healthy tuber (78.93 %) in K.JT against 66.45% in untreated control T₁ where as in K.CM T₆ was the best giving 82.47% of healthy tuber against 68.58% in untreated control T₅. Regarding the yield of potato tubers on K.CM and K.JT in T₃ and T₄ and again T₇ and T₈ were at par each other in both the potato varieties. Therefore, in weight basis in T₄ (8.58 t ha⁻¹) and T₈ (6.94 t ha⁻¹) recorded maximum yield of damage tubers than other treatments with Zn and B and T₄ and T₈ treatments recorded lowest yield of damage tuber than control in T₁ (10.15 t ha⁻¹) and T₅ (8.66 t ha⁻¹), respectively in both the varieties of potato *i.e.* K.JT and K.CM. In the next year of study during 2018-19, healthy tuber yield of potato on different micronutrients treatments ranged from 22.30 t ha⁻¹ to 26.10 t ha⁻¹ over control (21.16 t ha⁻¹) in weight basis in K.JT (Table 3). In K.CM, T₆ (26.26 t ha⁻¹) recorded highest yield of healthy tubers followed by T₇ (23.10 t ha⁻¹) over control T₅ (16.67 t ha⁻¹) which had significantly superior over control. Therefore, the damaged tubers was found maximum in T₃ (8.20 t ha⁻¹) and T₈ (8.97

t ha⁻¹) over control in T₁ (9.29 t ha⁻¹) and in T₅ (9.69 t ha⁻¹) in weight basis in the two potato varieties of K.JT and K.CM, respectively. Consequently, T₂ and T₆ gave the highest percentage of healthy tuber yield (80.75 % and 81.43 %) in both the potato varieties *i.e.* K.JT and K.CM, respectively (Table 3). However, all the treatments recorded significantly higher yield as compared to untreated control

(T₁ and T₅). It is therefore evident from the tables that combined application of both Zn and B achieved lowest percent tuber damage in both the potato varieties of K.JT and K.CM. It could be conclude from the present findings that the various treatments of Zn and B were significantly influenced to increase the healthy tuber yield of potato crop than the untreated control.

Table 2: Effect of zinc and boron on the aphid incidence in K. Chandramukhi and K. Jyoti during (Pooled data of two years)

Treatments	Population dynamics of aphids on different treatment schedules													Mean
	December				January				February				March	
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	
T ₁ =V ₂ B ₀ Zn ₀	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	4.00 (2.11)	9.00 (3.08)	12.33 (3.58)	15.00 (3.94)	17.33 (4.22)	20.00 (4.53)	24.00 (4.95)	28.00 (5.37)	21.00 (4.64)	18.33 (4.34)	13.00
T ₂ =V ₂ B ₁ Zn ₁	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	2.33 (1.68)	4.00 (2.11)	5.67 (2.48)	5.67 (2.47)	8.00 (2.91)	8.67 (3.03)	11.33 (3.43)	14.00 (3.80)	10.33 (3.29)	6.67 (2.67)	5.90
T ₃ =V ₂ B ₀ Zn ₁	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	3.00 (1.86)	6.67 (2.67)	9.33 (3.13)	9.33 (3.13)	13.33 (3.72)	15.67 (4.02)	18.00 (4.30)	20.00 (4.53)	16.67 (4.14)	12.67 (3.63)	9.59
T ₄ =V ₂ B ₁ Zn ₀	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	3.33 (1.93)	5.00 (2.34)	5.33 (2.41)	17.00 (4.12)	9.67 (3.19)	10.33 (3.29)	12.33 (3.58)	14.00 (3.81)	9.00 (3.08)	6.61
T ₅ =V ₁ B ₀ Zn ₀	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	5.00 (2.32)	12.00 (3.53)	16.00 (4.06)	16.00 (4.06)	24.00 (4.95)	25.67 (5.11)	27.00 (5.24)	30.00 (5.52)	28.00 (5.34)	22.00 (4.74)	15.82
T ₆ =V ₁ B ₁ Zn ₁	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	2.00 (1.47)	4.00 (2.12)	4.67 (2.27)	4.33 (2.20)	5.00 (2.33)	7.00 (2.74)	12.33 (3.58)	15.00 (3.93)	11.33 (3.44)	7.33 (2.79)	5.61
T ₇ =V ₁ B ₀ Zn ₁	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	3.00 (1.86)	4.33 (2.20)	5.33 (2.41)	5.33 (2.40)	6.33 (2.61)	10.00 (3.24)	12.00 (3.53)	14.67 (3.89)	10.33 (3.29)	8.67 (3.03)	6.15
T ₈ =V ₁ B ₁ Zn ₀	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	2.00 (1.52)	6.00 (2.53)	8.33 (2.97)	8.33 (2.97)	11.00 (3.38)	16.33 (4.10)	20.33 (4.56)	24.00 (4.95)	19.00 (4.12)	15.67 (4.02)	10.08
S.Em. (±)	-	-	-	0.16	0.13	0.08	0.15	0.12	0.10	0.08	0.10	0.10	0.12	-
C.D. 0.05	-	-	-	0.49	NS	0.24	0.45	0.36	0.30	0.25	0.30	0.31	0.36	-

*Figures in parentheses are square root transformed values. V1 = Kufri Chandramukhi; V2 = Kufri Jyoti

Table 3: Percent yield (weight basis) of healthy and damaged tubers under different micronutrient (Zn and B) treatments during 2017-18 and 2018-19

Treatment schedule	Healthy Tubers (t ha ⁻¹)		Damage tubers (t ha ⁻¹)		Percent yield of Healthy tubers (%)		Percent yield of damage tubers (%)	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
T ₁	20.10	21.16	10.15	9.29	66.45	69.49	33.55	30.51
T ₂	27.50	26.01	7.34	6.20	78.93	80.75	21.07	19.25
T ₃	25.67	22.30	8.54	8.20	75.04	73.11	24.96	26.89
T ₄	26.20	23.91	8.58	7.56	75.33	75.98	24.67	24.02
T ₅	18.90	16.67	8.66	9.69	68.58	63.24	31.42	36.76
T ₆	26.20	26.26	5.57	5.99	82.47	81.43	17.53	78.57
T ₇	23.20	23.10	6.72	6.93	77.54	76.92	22.46	23.08
T ₈	24.00	22.16	6.94	8.97	77.57	71.19	22.43	28.81

Conclusion

It could be concluded that application in combination of both zinc and boron was most effective in reducing the population of aphid in both the cultivars of potato *i.e.* Kufri Chandramukhi and Kufri Jyoti. The cultivar Kufri Jyoti (T₂) and Kufri Chandramukhi (T₆), when treated with both zinc and boron recorded lower aphid infestation. The yield of healthy potato tubers was also recorded higher in the above mentioned treatments as compared to untreated control. It was also revealed that the application of zinc and boron either in alone or in combination could not protect the crop from of insect pests attack during the entire period of crop growth period. However, boron had better performance than zinc regarding its single application on potato in both the varieties.

Acknowledgement

The authors are grateful to the Farm Manager of District Seed Farm, Department of Agriculture, Government of West Bengal, P.O. - Burdwan, Dist. - Burdwan and West Bengal for providing various facilities including land to

undertaken the present field experiment.

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