Entomon 43(1): 71-76 (2018)
Short Communication No. ent. 43112

Evaluation on the effect of mineral nutrition in the management of spotted pod borer *Maruca vitrata* (Fabricius) and Blue butterfly *Lampides boeticus* (L) of cowpea

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ABSTARCT: Experiments on the effect of mineral nutrients such as K, Mg, Ca, S, Cu, Zn, B and Si in the management of spotted pod borer and blue butterfly pest of cowpea, conducted during two seasons *viz*., rainy and summer season revealed that the treatment effects in which T_{12} (NPK+ Ca+ Mg+ 3 spray of foliar nutrients) significantly influenced pod borer infestation with minimum percent of infested pods in both seasons (9.9%, 0.0%) over absolute control (41.26%) and control(56.74%) in rainy and summer season respectively. In summer, pod borer incidence was comparatively low and treatments which received nutrient spray were found free of borer infestation. Pod borers per plant exhibited the same trend as that of percentage of pods infested.

KEY WORDS: Spotted pod borer, blue butterfly, mineral nutrition, cowpea pests

Cowpea, *Vigna unguiculata* belongs to family Leguminosae is one of the major vegetable crops grown widely throughout Kerala. It is rich in nutrients, containing a fairly high percentage of proteins. Due to rich protein content, its leaves and shoots support development of pest, with improved fecundity and longevity (Breukel and Post, 1959). This threatens both quality and quantity of the seed and pod yield. Among various insect pests, *Maruca vitrata* is highly damaging to the growing cowpea because of their vast host range and cosmopolitan distribution. It causes damage to the pods, flower buds and flowers of the plant resulting in 20 – 88 per cent yield loss (Jayasinghe *et al*., 2015). Evidence of suppression of pest attack by use of mineral nutrients has been reported by different researchers (Gogi *et al*., 2012; Habashy *et al*., 2010; Ebaid *et al*., 2006; Ghallab *et al*., 2014; Sarwar, 2011; Basagli *et al.*, 2003; Horng *et al*., 1990; Najafabadi *et al*., 2011). The timing, amount and type of mineral used can suppress or stimulate pest population, depending upon the pest species and the crop concerned. Knowledge about a plant's nutrition combined with dynamics of a pest can often provide an excellent basis for successful pest management (El-zik and Frisbie, 1985). Elements, when applied in adequate quantities, can impart resistance to pest and diseases (Span and Schumann, 2010).

Developing alternatives to pesticide is critical to maintain agriculture production. This is all the more true for Kasaragod district, which has been declared as an organic district and where synthetic

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insecticides are no more an option. With this background the present research work is proposed with objective to evaluate the effect of mineral nutrients particularly K, Ca, Mg, S, Cu, Zn, B and Si in the management of borer pests of cowpea viz., *Maruca vitrata* (Fab.) and *Lampides boeticus* (L.).

Experiment was conducted in CRD with 12 treatments including control and absolute control with 3 replications each in pot culture. The experiment was done in two seasons, *viz.* in the rainy season of 2016 (July - October) and summer season of 2017(January – April). The plants were raised in pots in three nutrient regimes namely, potting mixture, potting mixture + NPK and potting mixture + NPK + Ca + Mg. Later, the mineral nutrients were applied as foliar spray with 0.2 per cent concentrated solution prepared at Department of Soil Science, College of Agriculture, Padnekkad, Kasaragod containing K, Zn, Cu, B and Si at different time intervals *viz.* the branching stage, the peak branching stage and the flower bud initiation stage. The treatments were : T_1 - potting mixture (absolute control), T_2 - P.M + one nutrient spray, T_3 - P.M + two nutrient spray, T_4 - P.M + three nutrient spray, T_5 - P.M + NPK (control), T_6 - P.M + NPK + one nutrient spray, T_7 - P.M + NPK + two nutrient spray, T_8 - P.M + NPK + three nutrient spray, T_9 - P.M + NPK + Ca + Mg, T_{10} - P.M + NPK + Ca + Mg + one nutrient spray, T_{11} - P.M + NPK + Ca + Mg + two nutrient spray, T_{12} - P.M + NPK + Ca+ Mg + three nutrient spray. Monitoring of pests was done at biweekly intervals. Preliminary soil analysis was conducted to know the status of K, Ca, Mg, S, Cu, B, Zn and Si. The analysis of plant samples were carried out after the crop. About 1.5 times

Table 1. The percentage of infested pods in rainy season 2016 (n=6)

Treatments	15 DASP	30 DASP	45 DASP	60 DASP	Silicon in %
T_1	59.99 (.885)	28.00 (.557)	25.98 (.534)	41.73 (.702)	0.18
T_2	8.03 (.287)	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.26
T_3	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.33
T_4	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.35
T_5	74.99 (1.04)	68.14 (.971)	32.25 (.603)	56.74 (.853)	0.26
T_6	14.99 (.397)	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.27
T_7	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.33
T_8	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.41
T_9	0.00 (.008)	10.75 (.334)	12.63 (.363)	45.75 (.742)	0.38
T_{10}	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.44
T_{11}	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.48
T_{12}	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.00 (.008)	0.56
C.D.	23.05	10.83	8.57	23.78	0.03

Table 2. The percentage of infested pods in summer season 2017

Treatments	15 DASP	30 DASP	45 DASP	60 DASP	Silicon in %
T_1	33.83 (.621)	33.56 (.618)	28.55 (.563)	41.26 (.697)	0.21
T_2	30.81 (.588)	19.53 (.458)	26.48 (.540)	32.69 (.608)	0.27
T_3	26.88 (.545)	30.59 (.586)	26.82 (.544)	25.73 (.531)	0.32
T_4	17.70 (.434)	14.99 (.397)	21.72 (.484)	16.25 (.414)	0.41
T_5	46.27 (.748)	50.69 (.792)	32.26 (.604)	28.22 (.560)	0.32
T_6	25.75 (.532)	17.06 (.425)	23.85 (.510)	20.69 (.472)	0.29
T_7	21.75 (.485)	21.14 (.477)	20.31 (.467)	15.59 (.405)	0.37
T_8	18.85 (.449)	11.75 (.349)	21.44 (.481)	11.31 (.342)	0.44
T_9	27.37 (.550)	29.97 (.579)	45.34 (.738)	30.33 (.583)	0.36
T_{10}	23.54 (.506)	16.48 (.418)	20.38 (.468)	18.98 (.450)	0.47
T_{11}	33.84 (.620)	19.18 (.453)	19.99 (.463)	36.74 (.651)	0.46
T_{12}	11.75 (.350)	9.99 (.321)	16.06 (.412)	9.99 (.321)	0.54
C.D.	27.56	22.29	24.73	18.50	0.05

n=6;*DASP- days after spraying; *DAS- days after sowing

Table 3. Plant nutrient analysis in rainy season 2016

Treatment	Potassium %	Calcium %	Magnesium %	Sulphur %	Copper ppm	Zinc ppm	Boron ppm	Silicon %
T_1	0.59	0.10	0.14	0.20	3.21	19.07	49.15	0.21
T_2	0.63	0.11	0.15	0.21	7.25	20.25	54.65	0.27
T_3	1.41	0.12	0.19	0.24	6.25	22.26	55.32	0.32
T_4	1.62	0.16	0.20	0.24	5.26	22.96	58.38	0.41
T_5	0.99	0.12	0.15	0.23	5.12	21.28	53.36	0.32
T_6	1.68	0.17	0.18	0.24	5.19	22.28	54.35	0.29
T_7	1.29	0.16	0.18	0.23	6.29	23.36	54.85	0.37
T_8	1.49	0.19	0.18	0.26	7.91	23.98	57.56	0.44
T_9	1.29	0.15	0.17	0.27	7.25	22.32	56.21	0.36
T_{10}	1.72	0. 17	0.20	0.30	5.26	24.64	58.24	0.47
T_{11}	1.58	0.21	0.18	0.29	6.58	25.01	57.36	0.46
T_{12}	1.26	0.22	0.16	0.26	7.95	23.32	54.10	0.54
C.D.	0.02	0.01	0.01	0.03	2.20	NS	1.59	0.05

Table 4. Plant nutrient analysis in summer season 2017

Treatment	Potassium %	Calcium %	Magnesium %	Sulphur %	Copper ppm	Zinc ppm	Boron ppm	Silicon %
T1	0.65	0.14	0.14	0.24	4.70	22.07	46.89	0.18
T2	0.75	0.19	0.15	0.24	7.06	24.95	62.05	0.26
T3	1.73	0.20	0.17	0.26	5.41	27.74	63.89	0.33
T4	1.40	0.15	0.16	0.25	6.95	25.04	64.34	0.35
T5	1.05	0.15	0.14	0.22	5.01	24.45	47.42	0.26
T6	1.77	0.21	0.17	0.25	5.19	25.07	57.74	0.27
T7	1.39	0.17	0.15	0.30	6.89	26.07	53.21	0.33
T8	1.55	0.18	0.15	0.27	8.91	24.53	57.44	0.41
T9	1.38	0.18	0.16	0.26	7.71	23.85	56.99	0.38
T10	1.87	0. 19	0. 17	0. 31	4.48	26.38	58.10	0.44
T11	1.65	0. 24	0. 18	0. 26	6.32	28.45	60.75	0.48
T12	1.49	0.20	0.17	0.25	8.49	23.49	54.10	0.56
C.D. 0.05%	0.24	0.02	0.01	0.05	0.913	1.744	7.65	0.03

recommended quantity of N, P, K, Ca and Mg were added (as per Package of Practices recommendations, KAU (2011) were incorporated to the pot. Details of the quantity of chemical fertilizers per pot are as follows: Urea - 1.74g, Rajphos - 5.90 g, Muriate of potash - 1.80 g, Calcium carbonate - 10.13 g, Magnesium sulphate - 3.19 g. Observations on the damage caused by *Maruca vitrata* and *Lampides boeticus* were recorded as the number of infested pods and total number of pods.The plant samples were collected at the end of crop season and subjected to nutrient analysis for estimating the content of K, Ca, Mg, S, Cu, Zn, B and Si by using standard procedures (Jackson ,1958; Issac and Kerber, 1971; Bhargava and Raghupathi, 1995; Emmel *et al.*, 1977; Bingham, 1982; Korndorfer *et al.*, 2011). Data collected from the experiments were analysed using ANOVA after arcsine transformation.

Maximum infested pods was recorded in the control (T_5) with 46.27 % and 50.69 % on 15th and 30th day after spraying. Minimum infested pods was observed in T_{12} which were fertilized with 3 sprays + NPK + Ca + Mg with 11.75 %, 9.99 %, 16.06 % and 9.99 % on 15th, 30th, 45thand 60th day after spraying. In the summer season, maximum infested pods were found in control (T_5) followed by absolute control (T_1) and NPK + Ca +Mg (T_9). Treatments which has received nutrient spray was found to be free of infestation on 30th, 45thand 60th day after spraying in summer. Foliar nutrition (0.2 per cent) as one spray without and with NPK (T_2 and T_6) has shown some infestation on 15th day after spraying in summer season and it recovered after another 15 days (Table 1 and 2), which is in confirmation with the result of Sarwar (2011) who reported that use of K fertilizer @ 50 kg/ha is useful in the recovery of damage caused by larvae of rice stem borer and contributes to larger volume of yield. This indicates that foliar application of mineral nutrients has a significant effect on management of borer pest in cowpea and 2 to 3 times foliar fertilization with mineral nutrients containing Si, B, Zn, K and Cu is beneficial. The results are in line with the report of Mochiah *et al*. (2011) who observed that plants treated with NPK show highest leaf damage (31%) compared to absolute control (11 %) with pests such as *Plutella xylostella*, *Brevicoryne brassicae*, *Hellula undalis* and *Pieris rapae* in cabbage.

The highest K and S contents were recorded in T_{10}. Highest Si, B and Zn were recorded in $T_{12,}$ T_4 and T_{11} respectively, whereas lowest K, Ca Mg, B, Cu, Zn and Si were recorded by absolute control (Table 3 and 4). Significant differences in Si content in plants were noticed with foliar application of mineral nutrient mixture. 3 sprays of the mineral nutrient mixture along with soil application of NPK+ Ca + Mg recorded maximum concentration of silicon in the plant(0.54 %, 0.56 %), whereas, absolute control recorded minimum silicon content. Similar finding was reported by Lalithya *et al.* (2014) in sapota. So the high content of silicon might have increased the cell wall thickness. Silicon interferes with larval boring and feeding of rice striped borer (Ukwungwu and Odebiyi, 1985). Painter (1951), Takahashi (1996) and Epstein (1999) reported that Si deposited in the epidermal tissue may provide support and protection against pest as a mechanical barrier. Mandibles of larvae of the rice stem borer are damaged when the Si content of rice plants is high (Jones and Handreck, 1967). Zinc fertilization might have induced resistance through antibiosis or feeding inhibition to borer pest. Shu *et al*. (2009) reported that the application of Zinc has shown remarkable negative effect on the reproduction of phytophagous insect *Spodoptera litura* when they were reared on a diet containing 300-700 mg/kg of Zn. Application of zinc at 30 kg/ha markedly decreased the infestation of stem borer of rice, while application at 20-25kg/ha showed slightly more white head and dead heart incidence, but differed significantly from unfertilized plot. From the earlier reports and present study, it is clear that mineral nutrient such as Zn, Si and K are effective in the management of borer pest of cowpea.

Although more research is needed, this study suggests that mineral nutrients can influence the relative resistance of cowpea var. kanakamony to insect pests. Understanding how mineral nutrition improves plant health may lead to new and better integrated pest management and integrated soil fertility management designs.

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(Received 22 August 2017; revised ms accepted 10 February 2018; published 12 March 2018)