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Impact of nutrient application on aphid incidence on different varieties of Indian mustard, *Brassica juncea* L.

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Abstract
The investigation was carried on impact of nutrient application on aphid incidence on different varieties of Indian mustard, *Brassica juncea* during *Rabi* 2010-11 and 2011-12 at Student's Instructional Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.). Crop having only nitrogen application @ 80 kg/ha attracted maximum aphid of 51.70/10 cm twig in 2010-11 and 53.43/10 cm twig in 2011-12. However crop applied with nitrogen 80 kg/ha, phosphorus 40 kg/ha, potash 40 kg/ha and sulphur 30kg/ha attracted minimum aphid of 34.45/10 cm twig in 2010-11 and 38.19/10 cm twig in 2011-12. It may be concluded that the expression of growth, yield and net profit of mustard under the agro-climatic conditions of central plain zone of U.P. can be enhanced by application of balanced dosage of nutrients at timely application.

Keywords: *Lipaphis erysimi*, *Brassica juncea*, incidence, nutrients

Introduction
Rapeseed-mustard *Brassica juncea* (L.) is an important oilseed crop, which is a valuable source of edible oil. Mustard aphid (*Lipaphis erysimi* Kalt.) have been reported as a major constraint responsible for this low yield level, which causes average yield losses ranging 27.3-94.5% in Indian mustard due to aphid in U.P. [Singh and Malik, (1998) [10], Singh *et al.*, (2000) [8] and Malik *et al.*, (2003) [4]]. The infestation of aphid in rapeseed-mustard causes losses in seed yield along with the oil content in seeds. However, numbers of chemicals have been recommended for the management of this pest by several workers, but their indiscriminate use for suppressing the pest population increases the environmental hazards. Use of insecticides for the management of insect- pests in different crops is an integral part of integrated pest management, which should be eco-friendly, economically viable and socially acceptable. A number of newer chemicals have been registered in different groups for their better efficacy against different insect-pests. Thus, it is imperative to find out a selective molecule for the cost effective management of mustard aphid. Therefore, efforts were made to determine the efficacy and economics of some newer insecticides for the management of mustard aphid on Indian mustard in central Uttar Pradesh. Oilseed *Brassicas* also referred to as rapeseed-mustard, an important group of oilseed crops in the world, comprise eight cultivated crops of tribe Brassicaceae within the family cruciferae (Brassicaceae). Rapeseed-mustard is one of the important edible oilseeds spread in 53 countries over six continent in the world. Globally India accounts for 19.29 percent in total acreage and 11.27 percent in total production of rapeseed-mustard (USDA, 2013). The most important state of rapeseed-mustard growing in India is Rajasthan. The present study was done to observe the "Impact of nutrient application on aphid incidence on different varieties of Indian mustard, *Brassica juncea* L."

Materials and Methods
The field experiment was conducted at Students' Instructional Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during *Rabi* season 2010-11 and 2011-2012. Geographically, Kanpur is situated in the sub tropics with semi arid climate and situated between 25^0 26' – 28^0 58' North and longitude 79^0 31' – 80^0 34' East longitude at a height of about 125.9 meter above the sea level. The mean annual rain fall is about 800 mm in this area. The effect of different varieties on the incidence of the mustard aphid was observed on four varieties viz., Varuna, Vardan, Rohini and Urvashi raised in three replications under field

condition. These varieties were sown in November 2010-11 and 2011-12. All 4 treatment combinations (irrigation x genotypes) were tested in a split plot design with three replications.

Results and Discussion

Different nutrients viz., nitrogen, phosphorus, potash and sulphur were applied in different mustard varieties (Urvashi, Vardan, Varuna, and Rohini) to observe their effect on aphid incidence. The incidence of aphid was recorded starting from January, during 2010-11. The highest aphid incidence ranged from 13.46, 17.55, 21.62, 30.36, 44.48 and 63.84 aphids/10 cm twig on Urvashi during January 3rd, 4th, 5th, February 6th, 7th and 8th standard weeks in 2010-11, respectively and followed by 8.23, 12.53, 15.68, 21.80, 33.64 and 52.85 aphids/10 cm terminal shoot/plant on Vardan. Similar Varuna had 7.07, 11.08, 17.64, 22.94, 26.83 and 36.84 aphids/10 cm twig while lowest incidence of aphid was observed in Rohini with 5.85, 8.35, 13.70, 18.14, 22.18 and 27.24 aphids/10 cm terminal shoot/plant appeared on January 3rd, 4th, 5th, February 6th, 7th and 8th standard weeks in 2010-11, respectively (Table 1).

Table 1: Effect of nutrient application on aphid (*Lipaphis erysimi* Kalt.) incidence

	2010-11: Average No. of aphid incidence/10cm twig						2011-12: Average No. of aphid incidence/10cm twig					
	SW- 03	SW- 04	SW- 05	SW- 06	SW- 07	SW- 08	SW- 03	SW- 04	SW- 05	SW- 06	SW- 07	SW- 08
Urvashi	13.46 (3.67)	17.55 (4.19)	21.62 (4.65)	30.36 (5.51)	44.48 (6.47)	63.84 (7.99)	15.44 (3.93)	20.61 (4.54)	25.0 (5.00)	36.84 (6.07)	45.29 (6.73)	67.56 (8.22)
Vardan	8.23 (2.87)	12.53 (3.54)	15.68 (3.96)	21.80 (4.67)	33.64 (5.80)	52.85 (7.27)	10.30 (3.21)	16.24 (4.03)	18.31 (4.28)	25.20 (5.02)	37.82 (6.15)	55.35 (7.44)
Varuna	7.07 (2.66)	11.08 (3.33)	17.64 (4.20)	22.94 (4.79)	26.83 (5.18)	36.84 (6.07)	9.18 (3.03)	13.61 (3.69)	20.25 (4.50)	25.20 (5.02)	29.92 (5.47)	40.96 (6.40)
Rohini	5.85 (2.42)	8.35 (2.89)	13.70 (3.70)	18.14 (4.26)	22.18 (4.71)	27.24 (5.22)	7.56 (2.75)	11.08 (3.33)	16.40 (4.05)	21.34 (4.62)	25.80 (5.08)	31.47 (5.61)
SE(d)	0.10	0.03	0.14	0.16	0.17	0.21	0.11	0.14	0.15	0.18	0.21	0.27
CD (0.05)	0.22	0.29	0.31	0.34	0.37	0.45	0.24	0.30	0.32	0.39	0.46	0.58
T_1 -N_{80}	10.17 (3.19)	14.21 (3.77)	20.07 (4.48)	27.04 (5.20)	35.52 (5.96)	51.70 (7.19)	12.39 (3.52)	18.31 (4.28)	24.01 (4.90)	31.80 (5.64)	39.18 (6.26)	53.43 (7.31)
T_2-$N_{80}P_{40}$	9.18 (3.03)	13.17 (3.63)	18.23 (4.27)	24.80 (4.98)	32.38 (5.69)	47.19 (6.87)	11.08 (3.33)	16.48 (4.06)	21.06 (4.59)	28.51 (5.34)	35.80 (5.98)	52.56 (7.25)
T_3-$N_{80}P_{40}K_{40}$	8.12 (2.85)	11.90 (3.45)	16.81 (4.10)	22.09 (4.70)	28.94 (5.38)	43.95 (6.63)	9.98 (3.16)	14.44 (3.80)	18.92 (4.35)	25.60 (5.06)	32.60 (5.71)	48.16 (6.94)
T_4-N_{80} $P_{40}K_{40}$ S_{30}	6.50 (2.55)	9.54 (3.09)	13.24 (3.64)	18.83 (4.34)	26.31 (5.13)	34.45 (5.87)	8.41 (2.90)	11.90 (3.45)	16.0 (4.00)	21.99 (4.69)	30.14 (5.49)	38.19 (6.18)
SE(d)	0.10	0.12	0.11	0.15	0.19	0.19	0.13	0.13	0.16	0.19	0.20	0.27
CD (0.05)	0.21	0.24	0.24	0.31	0.40	0.39	0.27	0.29	0.33	0.38	0.41	0.54

NB: $T_1 – N_{80}$, $T_2 – N_{80} + P_{40}$, $T_3 – N_{80} + P_{40} + K_{40}$, $T_4 – N_{80} + P_{40} + K_{40} + S_{30}$ Sulphur dose and Figures in parentheses are square root transformed values $\sqrt{x} + 0.5$

The second year observations on aphid incidence were recorded starting from January 3rd standard week during 2011-12. The aphid incidence ranged 15.44, 20.61 and 25.00 showed that 36.84, 45.29 and 67.56 aphids/plant of terminal shoot/plant on Urvashi in January 3rd, 4th, 5th, February 6th, 7th and 8th standard weeks, respectively followed by 10.30, 16.24, 18.31, 25.20, 37.82 and 55.35 aphids/10 cm terminal shoot/plant on Vardan. Similar Varuna has 9.18, 13.61, 20.25, 25.20, 29.92 and 40.96 aphids/plant while population of aphid was observed in Rohini with 7.56, 11.08, 16.40, 21.34, 25.80 and 31.47 aphids/10 cm twig appeared on January 3rd, 4th, 5th, February 6th, 7th and 8th standard week 2011-12, respectively.

Different nutrients treatments viz., nitrogen (80 kg/ha), phosphorus (40 kg/ha), potash (40 kg/ha) and sulphur (30 kg/ha) were applied in mustard variety Rohini to observe their effect on aphid incidence. The first year observations on highest aphid incidence of 10.17, 14.21, 20.07, 27.04, 35.52 and 51.70 aphids/10 cm twig was recorded on nitrogen (80 kg/ha) in January 3rd, 4th, 5th, February 6th, 7th and 8th standard weeks during 2010-11.

The aphid incidence of 9.18, 13.17, 18.23, 24.80 and 47.19 aphids/plant was recorded on nitrogen (80 kg/ha) + phosphorus (40 kg/ha) in January 3rd, 4th, 5th, February 6th, 7th and 8th standard weeks during 2010-11 during fist year and aphid incidence was found to be 8.12, 11.90, 16.81, 22.09, 28.94 and 43.95 aphids/plants of terminal shoot/plant on nitrogen (80 kg/ha) + phosphorus (40 kg/ha) + potash (40 kg/ha) applied in January 3rd, 4th, 5th, February 6th, 7th and 8th standard weeks 2010-11 during, respectively. The application of balance does of different nutrients there was lowest aphid incidence of 6.50, 9.54, 13.24, 18.83, 26.31 and 34.45 aphids/10 cm twig treatment which received nitrogen (80 kg/ha) + phosphorus (40 kg/ha) + potash (40 kg/ha) + sulphur (30 kg/ha) in January 3rd, 4th, 5th, February 6th, 7th and 8th standard weeks during 2010-11 (Table-1).

Mustard variety Rohini grown with application of nitrogen (80 kg/ha), phosphorus (40 kg/ha), potash (40 kg/ha) and sulphur (30 kg/ha) to observe aphid incidence, the aphid incidence on nitrogen (80 kg/ha) 12.39, 18.31, 24.01, 31.80, 39.18 and 53.43 aphids/10 cm terminal shoot/plant on recorded in January 3rd, 4th, 5th, February 6th, 7th and 8th standard weeks 2011-12. Different nutrient balance dose of recorded the aphid incidence 11.08, 16.48, 21.06, 28.51, 35.80 and 52.56 aphids/plant on nitrogen (80 kg/ha) + phosphorus (40 kg/ha) in January 3rd, 4th, 5th, February 6th, 7th and 8th standard weeks during 2011-12.

The medium aphid incidence of 9.98, 14.44, 18.92, 25.60, 32.60 and 38.19 aphids/plants on nitrogen (80 kg/ha) + phosphorus (40 kg/ha) + potash (40 kg/ha) in January 3rd, 4th, 5th, February 6th, 7th and 8th standard weeks 2011-12. The application of balance dose of different nutrient observation the Lowest aphid incidence of 8.14, 11.90, 16.0, 21.99, 30.14

and 38.19 aphids/10 cm terminal shoot/plant recorded on nitrogen (80 kg/ha) + phosphorus (40 kg/ha) + potash (40 kg/ha) + sulphur (30 kg/ha) in January 3rd, 4th, 5th, February 6th, 7th and 8th standard weeks during 2011-12 (Table- 1).

Among the all varieties of mustard Urvashi, Vardan, Varuna and Rohini are having distinct inheritable characters. Rohini had the lowest aphid population of 5.85-27.24 aphids/10 cm terminal shoot/plant is most suitable variety for the aphid endemic areas while Urvashi showed highest aphid population of 13.46-63.84 aphid/plant is most susceptible to aphids. The remaining variety Varuna (7.07-36.84 aphid/plant), Vardan (8.23-52.85 aphid/plant) are tolerant to aphid infestation in first year 2010-11. The second year data recorded Urvashi found highest aphid population of 15.44-67.56 aphid/plant is most susceptible to aphids. However the remaining varieties Varuna (9.18-40.96 aphids/10 cm terminal shoot/plant) and Vardan (10.30-55.35 aphid/plant), on Rohini found the lowest (7.56-31.47 aphid/plant) infestation in first year (2011-12). The effectiveness of the granular insecticides at 40 kg/ha N was equal to that of the foliar sprays at 80 kg/ha Nitrogen. The higher level of nitrogen was more conducive to the development of the crop and the pest. On the basis of aphid abundance, yields and treatment costs, application of granular insecticides 40 days after sowing at 40 kg/ha N is recommended for the control of the pest. Singh and Singh (1989) [13] studied the effect of granular insecticides *viz;* aldicarb, phorate, disulfoton and dimethoate each at 1.5 kg a.i./ha applied 40 days after sowing which were compared nitrogen levels of 40 and 80 kg /ha for the control of *Lipaphis erysimi* on mustard. The effectiveness of the granular insecticides at 40 kg N was equal to that of the foliar sprays at 80 kg Nitrogen. The higher level of nitrogen was more conducive to the development of the crop and the pest. On the basis of aphid abundance, yields and treatment costs, application of granular insecticides 40 days after sowing at 40 kg N is recommended for the control of the pest. Sharma and Chauhan (1993) [9] observed that Indian mustard cv Pusa Bold receiving full crop management package (recommended N, P and K fertilizer rates of 80 kg N + 40 kg P_2O_5 + 20 kg K_2O/ha + 2 irrigations gave the highest seed yield and net profit compared with application of these inputs either singly or in various combinations. Yield increases were low with pest (5.38%) and disease (3.84%) control and high with the application of 100 (55%) or 50% (30%) of the recommended N, P and K fertilizer rate and 2 irrigation (35%). Singh *et al.* (1995) [11] reported an increase in infestation of Indian mustard [*B. juncea* cv. Varuna] by *Lipaphis erysimi*, with an increase in the level of nitrogen application, while significant reductions in infestation were observed due to the addition of phosphorus and potassium. The application of 40 kg N/ha together with 80 kg P_2O_5 and 40 kg K_2O/ha resulted in a considerable reduction in aphid infestation with a resultant increase in yield of the crop. Rohilla *et al.* (1996) [7] studied the abundance of Aphidoidea on 5 rapeseed cultivars (*Brassica campestris* cv. brown sarson BSH-1 and yellow sarson YSPb-24, *B. juncea* RH-30, *B. napus* HNS-3 and *B. nigra*). *Lipaphis erysimi* appeared on *B. napus* in the 3rd week of January and in the 1st week of January on all other cultivars. Infestation reached its peak on *B. napus* in the last week of February, and in the 2nd week on the other cultivars. Pest incidence increased with an average temperature of 13.7 ^{0}C and a relative humidity of 65%. It decreased with temperatures above 35 degrees ^{0}C, <60% relative humidity, >10 mm/day of rain and host crop maturity. Kumar *et al.* (1998) [2] noticed that the aphid infestation in mustard was increased with the enhancement of nitrogen application but application of optimum fertilizer dose (60 kg N, 40 kg P_2O_5, + 40 kg K_2O ha^{-1}) gave the best result both the terms of pest tolerance and crop yield. Saha and Baral (1999) [8] determined the effect of sowing date and potash levels on the incidence of mustard aphid, *Lipaphis erysimi*, on rape B-9 (Binoy). The crop was sown on 3rd November, 18th November and 3rd December with four levels of potash at 30, 45, 60 and 75 kg K_2O ha^{-1}. Crops sown on 3 December had a significantly higher number of *L. erysimi* (3.091 aphid incidence score) and gave a negative return compared to crops sown on 3 November (1.973 aphid incidence score). Crops sown on 18 November gave the highest net return. Potash had no significant effect on the incidence of aphids on all observation dates. However, applying potash at 45 kg ha\mins\1 resulted in the highest aphid incidence score (2.526), whereas the lowest score (2.345) followed potash application at 30 kg ha^{-1}. Negative correlations were observed for the last two dates of observation of aphids with yield. Yadu and Dubey (1999) [16] applied 0, 20, 40, 60 or 80 kg N/ha in Indian mustard (*Brassica juncea*) cv. Varuna yields increased with increasing N rate, while net profits were lower than in the control with 20 or 40 kg N, but were greater with 60 or 80 kg N. Yields and net profits were decreased by delay in spraying. Incidence of *L. erysimi* increased with increasing N rate and timely spraying of insecticides was significantly superior to late spraying. Praduman and Thakral (2001) [6]evaluated varieties of Indian mustard BIO-772, RL-1359, Kranti, Varuna and RH-30 against white rust, downy mildew and aphids infestation treated with 80 kg N/ha, 40 kg P_2O_5/ha, 40 kg K_2O/ha and 30 kg S/ha. Aphid infestation was minimum in BIO-772 treated with 80 kg N and 40 kg $P2O_5$ /ha, while maximum infestation was recorded in Varuna treated with 40 kg K_2O and 30 kg S/ha. Malik *et al.* (2003) [3] studied the impact of different agronomical inputs comprising various combinations of thinning (15 and 25 days after sowing, DAS) weeding (40 DAS), fertilizer (N 100, P 40, K 40 kg/ha), sulphur (30 kg/ha), against aphid *L. erysimi* Kalt. Indian mustard cv. Varuna. Significantly minimum aphid incidence (2.74 aphids/10 cm central shoot length) and superior seed yield (801.67 kg/ha) with higher net monetary return (Rs. 86467 ha) was recorded on the crop grown under the full package. The crop raised with all these inputs except weeding had significantly higher aphid incidence (5.95 aphids/10 cm central shoot length), but produced 1706.67 kg/ha seed yield, at par with the production level of crop grown with all inputs. The application of these inputs provided better crop growth in comparison to untreated crop. Significantly higher aphid population (19.30 aphids/10 cm central length) and the lowest seed yield (597.67 kg/ha) were recorded on untreated crop compared to treated ones. The extent of losses in seed production was estimated to be 66.82 per cent over those in untreated crop. Srivastava and Singh (2003) [14] reported the increase in the dose of nitrogenous fertilizers increase the population of mustard aphids, where as increasing dose of phosphorous resulted in decreased of its population. Jat *et al.* (2006) [1] recorded the infestation of aphid on mustard started in third week of January (48 aphids/5 plants) that the increased gradually, reached to its peak (295 aphids/5 plants) in the second week of February and disappeared completely after second week of March. The correlation coefficient workout between aphid population and morning and evening relative humidity showed a significant positive correlation (r = 0.485 and 0.464), respectively. Yesh *et al.* (2008) [15] carried out a field experiment during 2002-03 and 2003-04 in Uttarakhand, India to assess the extent of reductions in yield due to application of inorganic fertilizers below the

recommended level and also the benefits in yield due to integrated nutrient management (INM) in mustard (*Brassica juncea* cv. Kanti). The NPK levels applied were 100, 75 and 50% of recommended fertilizer (RF) through inorganic fertilizers alone and in combination. Significant reduction in yield and yield contributing parameters (such as number of branches, number of siliquae and plant height) was recorded with reduction in fertility levels during both years. Similar trend was recorded in uptake of N, P, K, S, Zn and B nutrients. Significantly highest values of plant height, number of branches, number of siliquae and seed and oil yield were recorded with T6 where complete INM package was applied along with 100% of RF, followed by T12 and T18 where the same INM package was applied along with 75 and 50% of RF level. Significantly higher uptake values of N, P, K, S, Zn and B were also recorded in these treatments. Mishra and Kamlesh (2009) [4] studied the effect of sowing dates and nitrogen levels on grain yield and incidence of *Lipaphis erysimi* in Indian mustard crop. Highest grain yield of mustard was obtained from crop sown on 15 October receiving 120 kg N/ha. Two years mean aphid population was maximum (19.7 aphids/5-cm twig) on mustard sown on 15 November and minimum (5.6 aphids/5-cm twig) was recorded in 15 October-sown crop. Significant increase in aphid population (9.5 to 15.5 aphids/5-cm twig) was observed with increase in nitrogen application from zero to 120 kg N/ha. Pachauri *et al*. (2012) [5] conducted field experiment was during rabi reason of 2008-09 and 2009-10 at Agricultural Research Farm of Raja Balwant Singh College, Bichpuri, Agra to study the effect of sulphur and zinc levels on mustard (*Brassica juncea*). The treatments consisted of four levels of sulphur (0, 20, 40 and 60kg/ha) and four levels of zinc (0.0, 3.0, 5.0 and 8.0 kg/ha) applied through elemental sulphur and zinc chloride in factorial randomize block design replicated thrice. Application of 40kg S/ha and 5 kg Zn/ha significantly increased seed and stover yield and yield attributes characters. Oil content and total uptake of N, P, K, S and Zn increased significantly up to 60 kg S/ha and 5.0 kg Zn/ha. Highest net return and benefit cost ratio were recorded with the application of 40kg S/ha and 5.0 kg Zn/ha.

Conclusion

The present investigation, efforts have been made to develop techniques of impact of nutrient application on aphid incidence on different varieties of Indian mustard, *Brassica juncea* L. The following conclusions have been drawn from the above study. Out of four important varieties of mustard viz., Urvashi, Vardan, Varuna and Rohini tested, Rohini was found moderately resistant while Urvashi was found most susceptible variety to mustard aphid. The aphid incidence starts from the last week of January. So that strategy to manage this pest should be made accordingly.

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