

(Original Article)



Variations in the Susceptibility of Some Potato Varieties to Infestation with Certain Piercing Sucking Insect Pests at Different Nitrogen Fertilization Levels in Assiut Area

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Abstract

Field experiment was conducted at Assiut area during the recommended sowing season 2021 to evaluate the relative susceptibility of three potato (*Solanum tuberosum* L.) varieties, Cara, Spunta and Burren to aphid, *Myzus persicae* (Sulzer), jassid / leaf hopper, *Empoasca discipiens* (Paoli), whitefly, *Bemisia tabaci* (Gennadius) and thrips, *Thrips tabaci* (Lindeman) infestation at three different nitrogen fertilization rates (60, 120 and 240 kg N/fed.). Results indicated that the varieties showed high significant differences in their susceptibility to certain piercing sucking insect pests. The infestation increased by increasing the rate of nitrogen. The highest numbers of aphid, jassid, whitefly and thrips were recorded at nitrogen level 240 kg/fed., where the populations were high at this rate as compared to the lower nitrogen rates, as well as control. In general, the rate of infestation of sucking pests was high in Cara cultivar at the double recommended nitrogen fertilization rate.

Keywords: *Potato varieties, Nitrogen fertilization, Piercing sucking insects.*

Introduction

Potato (*Solanum tuberosum* L.) is an herbaceous annual plant that belongs to the family Solanaceae and genus *Solanum*, and it has grown in more than 100 countries, under temperate, and subtropical conditions (Abbas *et al.*, 2015). Potato is the world's most important food crop ranked the 4th in production after rice, maize, and wheat (Bowen 2003). The total world potato production is estimated at 346.80 million tons in 2012. In Egypt, the total cultivated area was 381379 fed, (fed = 4,200 m²) which produced 4265178 tons, with an average of 11.18 tons/fed in 2013 of all seasons (Sharshar *et al.*, 2015). Egypt ranks among the world's top potato exporters (Mohamed *et al.*, 2013). The potato fields are inhabited by different insect species especially piercing-sucking insect pests. These insects are major pests on the vegetable plants for their direct damage by feeding on the plants, and by indirect damage as a virus vector to these plants.

Many researchers studied the sucking insect pests, and reported that the whitefly, *B. tabaci*, the green peach aphid, *M. persicae*, potato leaf hopper, *E. discipiens* and the onion thrips, *T. tabaci* attacked potato plants just after the first appearance of seedling until harvesting date (Mogahed, 2000; El-Khawas and Shoeb, 2004; Musa *et al.*, 2004; Saguez *et al.*, 2005; Saguez *et al.*, 2010; Fernandes *et al.*, 2015; Mogahed, 2015 and D'Auria *et al.*, 2016). Several reports have shown that the performance of phloem-feeding piercing-sucking pests is affected by slight changes in plant nitrogen (N) content. Harrewijn (1970) reported that the levels of total and soluble nitrogen in the leaves of potato plants and the reproduction rate of *M. persicae* were positively correlated with the amounts of nitrogen in the nutrient solutions. Meanwhile, Marzouk (1975) showed that the highest population density of *M. persicae* occurred in potato plants receiving high rates of fertilizers. Zebarth *et al.*, (2007) pointed out that nitrogen management is an important challenge, economically and environmentally. Darwish (2018) showed that potato cultivars tested had significant variation regarding their susceptibility against infestation by aphids and other sucking insects. Regarding these pests, nymphs and adults feed on young and soft parts of the plants. So, the present study was carried out to evaluate the susceptibility of three cultivars of potato (Cara, Spunta, and Burren) to piercing-sucking insect pest infestation at three different nitrogen fertilization levels.

Materials and Methods

Field experiments were carried out in Al-Atawla village, El-Fath Center, Assiut Governorate, Egypt, during the 2021 potato summer growing season.

The experimental area was 1/8 feddan (525 m²) divided into 12 equal plots (3 potato varieties × 4 treatments) distributed in a complete randomized block design each of about 42 m²; 6 m × 7 m or 6 m × 10 rows.

Three commercial imported potato varieties; namely Spunta, Burren and Cara were cultivated on the 5th of February in the 2021 summer season. Their varieties were obtained from the Al-Tawfiqia Village – Itay Al-Baroud Center, Beheira Governorate, Egypt. The cultivation of potato tubers was put at a depth of 10-15 cm under soil and 20-25 cm apart.

Ammonium nitrate (33.5% N) was applied one time 2 weeks after the sowing date as follows:

- 1- 60 kg N/fed. (the half-recommended level).
- 2- 120 kg N/fed. (the recommended level).
- 3- 240 kg N/fed. (2-fold of the recommended level)
- 4- Control without fertilization. All the recommended agricultural practices were adopted for all the experimental field plots. No chemical insecticidal treatments were used during the growing season.

Foliage samples

In aphid *M. persicae*, the foliage samples were taken after germination of potato seeds, and weekly samples of 75 potato leaves of each variety were picked at random 25 leaves/ plot. Samples were then placed in paper bags then transferred to the laboratory for examination.

For the other insects, white fly, thrips and leaf hopper the foliage samples were taken also after the germination of potato seeds, and weekly samples were taken by the sweep-net technique. 120 double sweeps in three replicates for each variety. insects were identified and counted.

Statistical analyses

All obtained data were subjected to analysis of variance and treatment means were compared for significant differences using the LSD at $p \leq 0.05$. The MSTAT-C computer program was used to perform all analysis of variance with the procedure outlined by Steel and Torrie (1982).

Results and Discussion

Data (Tables 1, 2, 3 and 4) represent the means of weekly numbers of aphid adults and nymphs, leaf hopper, whitefly, and thrips on three cultivars of potato plants namely, Cara, Spunta, and Burren. The three tested cultivars of potato showed different resistance rates against piercing insect pests at the three different nitrogen fertilization rates.

Results in Table (1) indicated that Cara cultivar showed the highest numbers of the green peach aphid, with an average of 74.92 individuals/25 leaves at the date of 5th April 2021 at the double normal recommended rate of fertilization, while the lowest average numbers of aphid/leaves were recorded on 26th April (15.80 individuals) at the half of the normal rate of fertilization. While in Spunta cultivar the highest number of aphid occurred on 29th March (30.58 individuals) in plants receiving double the normal recommended rate of fertilization. The lowest mean numbers were recorded on 26th April (4.92 individuals/ leaves) at half the normal leaves of fertilization. Also, in the Burren variety, the highest number of aphid was recorded on 29th March (17.00 individuals/25 leaves) to plants receiving double the normal recommended rate of fertilization, while the lowest number of aphid was recorded on 26th April (0.72 individuals) at half the normal rates of fertilization. Statistical analysis showed highly significant differences between all the treatments (varieties, nitrogen fertilization rates and inspection dates), the L.S.D. values were (0.493, 0.570 and 0.753, respectively). Among the different potato cultivars, Cara recorded the highest attraction of aphid at all inspection dates and nitrogen fertilization rates (35.99 individuals/25 leaves), while the Burren cultivar exhibited the lowest infestation (6.854 individuals/25 leaves).

Table 1. The average number of nymphs and adults, of *M. persicae* on three potato varieties at three nitrogen fertilization levels during summer plantation of 2021 at Assiut Governorate

Varieties	Nitrogen application rates (kg/fed.)	Average number of adults and nymphs/25 leaves							Mean
		Inspection dates							
		15 March	22 March	29 March	5 April	12 April	19 April	26 April	
Cara	Control	44.72	25.08	20.72	67.16	42.80	27.04	24.36	35.98
	60	45.80	21.28	18.76	57.76	28.84	19.08	15.80	29.62
	120	47.72	24.68	19.88	69.44	43.64	27.28	23.92	36.65
	240	51.80	28.72	23.60	74.92	49.60	33.52	29.72	41.70
	Mean	47.51	24.94	20.74	67.32	41.22	26.73	23.45	35.99
Spunta	Control	17.00	21.84	19.12	10.48	13.06	17.68	8.56	15.39
	60	10.04	11.28	14.38	6.98	8.24	14.96	4.92	10.11
	120	13.32	19.12	19.54	9.48	12.22	15.76	8.00	13.92
	240	21.96	28.92	30.58	15.90	20.46	27.68	9.84	22.19
	Mean	15.58	20.29	20.91	10.71	13.50	19.02	7.83	15.40
Burren	Control	5.28	6.44	9.56	3.32	3.68	4.20	2.84	5.046
	60	5.80	7.12	6.28	2.78	0.84	0.76	0.72	3.471
	120	6.32	12.92	9.32	4.64	7.00	4.32	1.84	6.623
	240	12.00	16.44	17.00	10.60	10.52	12.08	7.30	12.28
	Mean	7.35	10.73	10.54	5.335	5.510	5.340	3.175	6.854
N x D	Control	22.33	17.79	16.47	26.9	19.85	16.31	11.92	18.81
	240	28.59	24.69	23.73	33.81	26.86	24.43	15.62	25.39
	120	22.45	18.91	16.25	27.85	20.95	15.79	11.25	19.07
	60	20.55	13.23	13.14	22.51	12.64	11.60	7.147	14.40
General mean		23.48	18.65	17.40	27.79	20.08	17.03	11.49	
F test and LSD 0.05			F test				LSD 0.05		
Var.			**				0.493		
N			**				0.570		
V x N			**				0.987		
D			**				0.753		
D x V			**				1.307		
D x N			**				1.501		
V x N x D			**				2.610		

** highly significant (P>0.01)

Data given in Table (2) represent the number of leaf hoppers (Jassid) (30 double sweeps) on the three tested potato varieties at three different nitrogen fertilization rates. In the Cara cultivar, the highest number of leaf hoppers was recorded on 19th April with an average of 45.00 adults/double sweeps at a fertilization rate of 240 kg N/fed., while the lowest number was recorded on 6th April with an average of 10.00 adults/30 double sweeps, at the half-normal rate of fertilization. Also, in the Spunta variety, the highest number of- the leaf hopper was recorded on the 19th of April (32.00 adults/30 double sweeps) at (240 kg N/fed.), while the lowest number of the Jassid was recorded in the first and last week of April (10.0 adults/30 double sweeps). However, in the Burren variety the same trend was noticed with the first and second varieties, the highest number of leaf hoppers (24.00 adults/30 double sweeps) was recorded on 19th April at a fertilization rate was 240 kg N/fed, while the lowest mean of numbers was (10 adults/30 double sweeps). Generally, Cara cultivar recorded the highest number of leaf hoppers through the three tested cultivars of potatoes at all different nitrogen

fertilization rates (22.49 adults/30 sweeps). The lowest number of leaf hoppers was in the Burren cultivar (13.15 adults/30 double sweeps).

Table 2. The average number of adults, of *E. discipiens* on three potato varieties at three nitrogen fertilization levels during the summer plantation of 2021 at Assiut Governorate

Varieties	Nitrogen application rates (kg/fed.)	Average number of adults/30 double sweeps				Mean
		Inspection dates				
		6 April	13 April	19 April	26 April	
Cara	Control	15.87	14.00	15.00	12.00	14.22
	60	10.00	19.00	30.00	23.33	20.58
	120	12.00	24.67	37.00	26.00	24.92
	240	16.00	30.00	45.00	30.00	30.25
	Mean	13.47	21.92	31.75	22.83	22.49
Spunta	Control	12.00	14.00	10.00	4.00	10.00
	60	10.00	16.00	21.00	10.00	14.25
	120	12.00	17.00	25.00	12.00	16.50
	240	14.00	21.00	32.00	15.00	20.50
	Mean	12.00	17.00	22.00	10.20	15.31
Burren	Control	10.00	11.00	7.00	5.00	8.25
	60	13.00	14.00	13.00	11.00	12.75
	120	13.00	16.00	20.00	10.00	14.75
	240	15.00	17.00	24.00	11.33	16.83
	Mean	12.75	14.50	16.00	9.33	13.15
N x D	Control	12.62	13.00	10.67	7.00	10.82
	240	15.00	22.67	33.67	18.78	22.53
	120	12.33	19.22	27.33	16.00	18.72
	60	11.00	16.33	21.33	14.78	15.86
General mean		12.74	17.81	23.25	14.14	
F test and LSD 0.05		F test		LSD 0.05		
Var.		**		0.790		
N		**		1.368		
V x N		**		0.790		
D		**		1.368		
D x V		**		1.579		
D x N		**		2.737		
V x N x D		**		0.790		

** highly significant (P>0.01)

Data (Table 3) showed the number of whitefly /30 double sweeps on the three tested potato varieties at the three different nitrogen fertilization rates. In the Cara variety, the highest average number of- the whitefly was 35.00 adults/30 double sweeps on the 15th of March 2021 at the double normal recommended rate of fertilization, while the lowest mean numbers of whitefly/30 double sweeps were recorded on 22nd March (6.00 adults/30 double sweeps) at the half normal rates of fertilization. In the Spunta cultivar, the highest number of whiteflies was recorded on 15th March (27.00 adults/30 double sweeps) to the plants receiving double the normal recommended rate of fertilization. The lowest average number was recorded on 22nd March (8.00 adults/30 double sweeps) at the half-normal recommended rate of fertilization. In the Burren variety, the same trend was noticed with the first and second varieties, the highest number of whiteflies (15.00 adults/30 double sweeps) was recorded on 15th March at a fertilization rate was 240 kg N/fed. The lowest average number of whiteflies was recorded on 22nd

March (7.00 adults/30 double sweeps). at the half and normal fertilization rates. In summary, the Cara cultivar exhibited the highest number by whitefly through the three tested cultivars of potato at all different nitrogen fertilization rates, (18.58 adults/30 double sweeps), while the Burren cultivar recorded the lowest numbers (8.875 adults/30 double sweeps).

Table 3. The average number of, *B. tabaci* adults on three potato varieties at three nitrogen fertilization levels during the summer plantation of 2021 at Assiut Governorate.

Varieties	Average number of adults/30 double sweeps			Mean
	Nitrogen application rates (kg/fed.)	Inspection dates		
		15 March	22 March	
Cara	Control	23.00	15.00	19.00
	60	20.00	6.00	13.00
	120	28.67	8.00	18.33
	240	35.00	13.00	24.00
	Mean	26.67	10.50	18.58
Spunta	Control	14.33	6.00	10.17
	60	17.00	8.00	12.50
	120	20.00	9.00	14.50
	240	27.00	10.00	18.50
	Mean	19.58	8.25	13.92
Burren	Control	7.00	5.00	6.00
	60	10.00	7.00	8.50
	120	12.00	7.00	9.50
	240	15.00	8.00	11.50
	Mean	11.00	6.75	8.875
N x D	Control	14.78	8.667	11.72
	240	25.67	10.33	18.00
	120	20.22	8.00	14.11
	60	15.67	7.00	11.33
	General mean	19.08	8.500	
F test and LSD 0.05		F test	LSD 0.05	
Var.		**	0.843	
N		**	0.974	
V x N		**	1.687	
D		**	0.689	
D x V		**	1.193	
D x N		**	1.377	
V x N x D		**	2.385	

** highly significant (P>0.01)

Results in Table (4) showed highly significant variations in the number of thrips at the three different nitrogen fertilization rates. In the Cara cultivar the lowest number with thrips was recorded on 26th April was 6.00 adults/30 double sweeps at a fertilization rate of 120 kg N/fed., while the highest number was recorded on 6th April (25.00 adults/30 double sweeps) at 240 kg N/fed. In the Spunta cultivar, the highest infestation rate with thrips was recorded on the 13th of April (20.00 adults/30 double sweeps) when the fertilization rate was 240 kg N/fed., while the lowest number was noticed on 26th of April (5.00 adults/30

double sweeps) under the normal rate of nitrogen fertilization (120 kg N/fed.). However, in the Burren cultivar, the highest number of thrips took the same trend as the first and the second cultivars at the fertilization rate of 240 kg N/fed., the lowest number was recorded on 26th April (4.00 adults/30 double sweeps) at both fertilization rates (60 and 240 kg N/fed.). Comparing average infestation rates of the three cultivars under the three different fertilization rates. Cara cultivar exhibited the highest number of thrips (14.50 adults/30 double sweeps). Moreover, the lowest infestation rate with thrips was observed in the Burren cultivar (8.083 adults/30 doubled sweeps) at all inspection dates and under all tested fertilization rates.

Table 4. The average number of, *T. tabaci* adults on three potato varieties at three nitrogen fertilization levels during the summer plantation of 2021 at Assiut Governorate

Varieties	Average number of adults /30 double sweeps					
	Nitrogen application rates (kg/fed.)	Inspection dates				Mean
		6 April	13 April	19 April	26 April	
Cara	Control	15.00	17.00	9.00	5.00	11.50
	60	19.33	16.00	11.00	7.00	13.33
	120	20.00	21.00	14.00	6.00	15.25
	240	25.00	23.00	15.60	8.00	17.90
	Mean	19.83	19.25	12.40	6.500	14.50
Spunta	Control	8.00	6.00	5.00	4.00	5.750
	60	11.00	13.00	6.00	6.00	9.000
	120	17.00	16.00	8.00	5.00	11.50
	240	18.00	20.00	10.00	6.00	13.50
	Mean	13.50	13.75	7.250	5.250	9.938
Burren	Control	7.00	6.00	3.00	3.00	4.750
	60	8.00	9.00	5.00	4.00	6.500
	120	11.00	13.00	7.00	6.00	9.250
	240	14.33	17.00	12.00	4.00	11.83
	Mean	10.08	11.25	6.750	4.250	8.083
N x D	Control	10.00	9.667	5.667	4.000	7.333
	240	19.11	20.00	12.53	6.000	14.41
	120	16.00	16.67	9.667	5.667	12.00
	60	12.78	12.67	7.33	5.667	9.611
	General mean	14.47	14.75	8.00	5.333	
F test and LSD 0.05		F test		LSD 0.05		
Var.		**		0.481		
N		**		0.554		
V x N		**		--		
D		**		0.554		
D x V		**		0.961		
D x N		**		1.110		
V x N x D		**		1.922		

** highly significant (P>0.01)

For all studied pests statistical analysis showed highly significant differences in the number of insects between, variety, fertilization rate, sampling date, the interaction between variety and fertilization, sampling date and variety, sampling

date and fertilization rate, as well as the interaction between, variety, fertilization rate and sampling date.

Discussion

Many studies have investigated the susceptibility of different cultivars of different crops to several piercing insect pests, Musa *et al.* (2004) studied the sensitivity of two potato cultivars (Romano and Desiree) to *M. persicae*, Mogahed (2015) studied the sensitivity of Nicola and Spunta cultivars to aphid, jassid and whitefly.

Although no cultivar showed 100% resistance against the sucking insect pests. The present results proved that different cultivars of potato plants have different resistance capacities against piercing-sucking insect pests, the most susceptible cultivar was Cara followed by Spunta, whereas Burren showed more resistance against sucking insect pests. In general, the mean number of aphids and leafhopper populations was more abundant compared to that of whitefly or thrips populations. These results are relatively in harmony with those obtained by Mogahed, 2015 who found that each of the leafhopper, *E. discipiens* and whitefly, *B. tabaci* were more present in the potato plants than other piercing pests. In Pakistan, Ali *et al.* (2011) found that the population density of aphids per leaf of potato plants was more abundant than leafhopper and whitefly populations before the treatment with some chemicals against the aphids, Jassids, and whitefly. On the other hand, the levels of nitrogen fertilizer play an important role in the population build-up of sucking pests. In the present study, the mean population of all pests was high at the higher level of N as compared to those at low rates (60, 120 kg) and control. A positive correlation between insect pests and nitrogen fertilizer was found in this study. The findings of this study are in conformity with the earlier results of (Rustamani *et al.*, 1999; Andrew *et al.*, 2000; and Bi *et al.*, 2003) who found the same result in cotton. In the present research study, the Burren variety at half the normal recommended fertilization rate harbored the lowest numbers of sucking insect pests on the three tested potato varieties, however, the antibiosis test, variety Cara at double recommended fertilization rate has shown low resistance to all piercing-sucking insect pests.

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الاختلافات في حساسية بعض أصناف البطاطس للإصابة ببعض الآفات الحشرية الثاقبة الماصة عند مستويات مختلفة من التسميد النيتروجيني في منطقة أسيوط

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الملخص

أجريت تجربة حقلية بمنطقة أسيوط خلال موسم الزراعة 2021 لتقييم الحساسية النسبية لثلاثة أصناف من البطاطس (*Solanum tuberosum* L.) وهي كارا، سبونتأ، وبرن للإصابة بحشرات المن (*Myzus persicae* (Sluzer)، الجاسيد (نطاط الأوراق) (*Emposca discipiens* (Paoli)، الذبابة البيضاء (*Bemisia tabaci* (Gennadius) والتربس (*Thrips tabaci* (Lindeman) عند ثلاث معدلات مختلفة من التسميد النيتروجيني (60، 120، 240 كجم نيتروجين/فدان). أشارت النتائج إلى أن جميع الأصناف أظهرت فروقاً عالية المعنوية للإصابة ببعض الآفات الحشرية الثاقبة الماصة، كما تزداد الإصابة بزيادة معدل التسميد النيتروجيني. وسجلت أعلى أعداد للمن، الجاسيد، الذبابة البيضاء والتربس عند ضعف مستوى التسميد النيتروجيني 240 كجم/فدان بالمقارنة بالمستويات الأخرى، وعموماً كان أعلى معدل للإصابة بالحشرات الثاقبة الماصة مرتفعاً في الصنف كارا بالمقارنة مع الأصناف الأخرى وذلك عند ضعف المعدل الموصى به من التسميد النيتروجيني.