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Impact of Planting Date, N. Fertilization and Infestation Rate by Cowpea Worm *Etiella zinckenella*, (Treitschke) Treated with *Trichogramma evanescens*, (Westwood) on Dry Seed Yield of Cowpea *Vigna unguiculata*, L.

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Anany, T. G.[1*] **and I. M. Yahya**[2]

[1] Veg. Crops Seed Prod. & Tech. Dep, Hort. Res. Ins., Agric. Res. Centre, Giza, Egypt
[2] Plant Protection Research Institute, Agriculture Research Center, Giza, Egypt.

ABSTRACT

Two-field experiments were carried out during two-successive summer-seasons (2015-2016) at Vegetables-Research-Farm, Kaha-Qalubia-Governorate, Egypt. Study aim to investigate three-dates effect of sowing (1st-April, mid-April and 1st-May) and two-mineral nitrogen recommended doses 100 and 50% under field of *Etiella zenckenella* controlled by (*Trichogramma*), and their interactions on growthing, nutrient concentration, yield and components of cowpea-plants (*Vigna unguiculata* L.) “Kafr El-Sheikh cv.”. Obtained results showed, first sowing-date was desirable significant effect on growth, yield and components i.e. seed number/pod, weight 100-seeds and seed yield/feddan in both seasons. Also, 1st-sowing-date×60kg/fed N-dose with *Trichogramma* releasing recorded, highest vegetative growth characteristics, yield traits, highest nitrogen concentration, phosphorus, potassium and protein-content in seeds. Also, full nitrogen dose (60kg/Fedd.) along with *Trichogramma* utilization at all sowing-dates gave best growth parameters and seed yield. Infested%/pods decreased after *Trichogramma* treatments with about 54.1, 42.4 and 39% in 1st-season and 82.3, 82 and 78.5%, in 2nd, at 1-April, Mid-April and 1-May, when compared with control. However, significant differences in infested%/pods were observed between three planting-dates. Moreover, infestation% increased by delaying planting-date in both seasons. No significant differences were found in percent reduction of % infested pods between 1st and 2nd planting-dates of cowpea treated with *Trichogramma*. It could be recommended release of egg parasitoid *T. evanescens* combined with select 1-April planting-date against *E. zinckenella.*

Keywords: Cowpea, sowing-dates, nitrogen rates, growth, nutrient concentrations, seed yield and quality.

INTRODUCTION

Cowpea (*Vigna unguiculata* L.) is one of the major summer crops grown in Egypt for local consumption. Cowpea fresh pods or dry seeds had a high nutritional values due to their high contents of carbohydrates, proteins, vitamins and minerals (Smart, 1990). Thus, it is a cheap source of protein for the rural and urban poor countries (Fawole *et al.*, 2006). Poor production practices including lack of information on the right planting date has contributed to the low cowpea productivity (Alidu, 2019). However, Planting of cowpea should be in time in relation to maturity period of the variety such that the crop is harvested in a bright dry weather. There are many constrain including insect pests as vital one for the production of cowpea in field and during storage causing severe economic damage (Caswell, 1981). Cowpea pod borer (*E. zinckenella*) is one of the most dangerous enemies (Abdullah *et al*. 1994), which usually occurred damage on pods and fed only on seeds (Van Den Berg, *et al.* 1998). Consequently, the entire pods are destroyed during the reproduction phase of the crop resulting in a large loss of yield at harvest, and may reach 54.4% during harvest in cowpea, (Ohno and Alam, 1989 and Zayed and Mohamed, 2003). Many authors, *i.e.*, Jihan and Abdullah (2006), Hallalia *et al.* (2011) and Mahmoud (2011) studied the effect of planting dates on the incidence of the cowpea pod borer Etiella zinckenella and evaluated selected pesticides against it in cowpea. The vegetative growth and seed yield of cowpea were affected significantly by biotic and abiotic stresses. Sowing dates exhibit their effects on plants by affecting various physiological processes. Sowing dates had a significant effect on most seed characters including duration from sowing to emergence (Delouche, 1980). Early sown cowpea resulted in significant increase in most plant traits. Also, delaying in sowing dates significantly reduced all the yield characters assessed (Samndi *et al*., 2014). Moreover, Dongkwant *et al*., (2014) found that the days from first cowpea flowering to harvesting were short for the sowing dates between mid-March and mid-May (24 to 28 days). In principle, delay in sowing beyond and optimum date results in a progressive reduction in the potential yield of the crop (Varshney, 1995). Seed yield is affected very much by environmental factors prevailing at the time of seed development. Siddique *et al*. (2002) stated that seed yield generally decreased in delayed sowing. Also, nitrogen nutrition is one of the paramount factors which influence growth and yield potential of many different vegetable crops. Many investigators studied suitable application of nitrogen to the growing cowpea plants to attain favorable enhancing effects on growth, yield and quality. Trevino and Murray (1975) used nitrogen doses 0, 50 and 100ppm N for pea cultivation and found that nitrogen fertilization with 50 ppm N increased total seed protein due to an increase in protein/seed and higher seed yield. Stevovic *et al.* (2003) found that the highest dry matter yield at the stage of flowering and at the milk-waxy maturity stage was obtained in the first study year in the treatment

* **Corresponding author.**
E-mail address: ***drtarekanany@gmail.com***
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receiving 60 kg/ ha N. The crude protein yield varied in accordance with the dry matter yields.

Therefore, the aim of this study to find out the appropriate environmental ways for cowpea to control the legume pod borer, *i.e.,* planting date, nitrogen application and biological control.

MATERIALS AND METHODS

Two field experiments were carried out during two successive summer seasons of 2015 and 2016 at the Experimental Farm of Vegetables, Horticulture Research institute, Agriculture Research Centre at Kaha, Qalubia Governorate, Egypt to study the response of cowpea plants against *E. zinckenella* at three planting dates and three nitrogen levels as well as the role of the local egg-parasitoid, *Trichogramma evanescens* in reducing the insect infestation comparing with untreated treatment. Cowpea (*Vigna unguiculata* L.), "Kafr El-Sheikh cv." seeds cultivated in clay loamy soil.

Treatments and Experimental Layout:

The treatments of the two experiments were arranged in a split plot design with three replications, where planting dates were assigned at random in the main plots while sub plots were devoted to Nitrogen treatments as following:

a-Main plot (planting dates): three planting date (PD) treatments, i.e., 1st April, 15th April and 1st May

b- Sub plot (Nitrogen levels):

1. Control treatment (100%NPK without *T. evanescens* releases).
2. Two N levels with *Trichogramma* releases, *i.e*., 100% N and 50% N

Trichogramma rearing

The egg parasitoid, *Trichogramma* is mass reared in the laboratory on Angoumois grain moth, *Sitotroga cerealella* eggs. Eggs (2.0-2.25 gm) glued to cards (9X14 cm.) and exposed to *Trichogramma* adults in glass jars (1-3liters capacity) and covered with cloth. Usually, a parasitoid: host ratio of 1: 3 are used. Rearing took place at constant temperature of 25 ± 1°C and 80 ± 5 % R.H

Parasite releasing:

Typically, the wasps are released as parasitized eggs affixed to a card. The release bag (3x4cm) which contained three small cards with three ages of parasitized eggs, give three waves of wasps at 3-days intervals, were placed between the upper leaves of cowpea plants at rate of 30 cards/fed, each produced 1000 individuals resulting in Releasing of *T. evanescens* at rate of 30,000 wasps/fed. The parasitoid was released six times, the 1st one was at 30 days after plant emergence and repeated each at least one week interval. Cardboards were hand-placed on five randomized selected release points per treatment. In both seasons, the parasitoid was released in a total area of about 0.5 feddan (as 2000 m^2). The area divided into 18 plots treated with *Trichogramma evanescens* releasing (3 PD × 2 N levels × 3 replicates) in addition to 9 majors plots (3 PD × 3 replicates) untreated as control and the other areas (10 m width along the length of the experimental plots, about 64.8 × 10 m^2) was left without releases as spatial separator between the treated plots and the control plots and no experimental data were recorded on. Each plot included 6 rows, 13 m long with 0.60 m distance between rows. Accordingly, Plot sizes were 3.6 × 13 m in all experimental plots except the control which fed 100%N without *T. evanescens* releasing (in which the plot size was 7.2 × 7 m^2).

Cultural practices:

The distance between plants was 7 cm. All the treatments were fertilized with the recommendation rates of PK, *i.e*., 30 units P_2O_5/fed and 50 units K_2O/fed. Calcium superphosphate (15.5% P_2O_5) was added once before planting as a source of phosphorus. Both ammonium nitrate (33.5% N, as nitrogen source) and potassium sulphate (48% K_2O, as a source of potassium) were applied and divided along the growing season. The other agricultural practices were applied according to the instructions laid down by the Ministry of Agriculture, Egypt and the plants were left for the natural infestation. The physical and chemical analyses of the experimental soil are Physical properties as Organic matter (0.98%) and Textural class (Clay loam) and Chemical properties as PH (7.9), Electric conductivity E. C. (0.62 ds/m) and available nutrients (ppm) as Macro-elements [N (86), P (5.5) and K (209)] as well as Micro-elements [Zn (0.39), Mn (1.44), Fe (1.09) and Cu (0.59)]. Local meteorological data at experimental region during summer seasons of 2015 and 2016 were shown in Fig**.**1**.** All treatments were randomly arranged in a randomized complete blocks design with three replicates.

Data recorded:

At harvest-time, samples of ten plants were randomly chosen from the six central rows of each sub-plot and were marked in the field from the flowering to the harvest time to record vegetative growth traits (plant height, PH and number of branches, NB/P), yield and its attributes (number of pods/plant, NPd/P, number of seeds per pod, NS/Pd, weight of 100-seeds, SI/g and dry seed yield, DSY Kg/fed), germination traits (germination percentage, G/%, germination rate, GR/day and seedling length, SL/cm), Seeds constituents (N, P, K) and Protein content, Pr %. Plant nutrients (N, P and K) content in the cowpea seeds were estimated as reported by Allen *et al.* (1974) and analyzed by using Atomic Absorption Spectrophotometer (AAS). Crude protein content was determined by multiplying the nitrogen content of the seeds for each treatment by a conversion factor of 6.25 (Okwu *et al*., 2006).

The germination rate was calculated according to the following equation

$$\textbf{Germination rate} = \frac{(G1\ x N1) + (G2\ x\ N2) + ...(Gn\ x\ Nn)}{G1 + G2 + ...Gn}$$

Where: G = Number of germinated seeds in certain day. N = Number of the certain day.

Infested pods % and the reduction percentages of infestation after each treatment of release comparing with untreated plants (control) were estimated using the formula (Henderson and Teleton, 1955) as following:

$$\%Re = \frac{\text{Control - Treatment}}{\text{Control}}$$

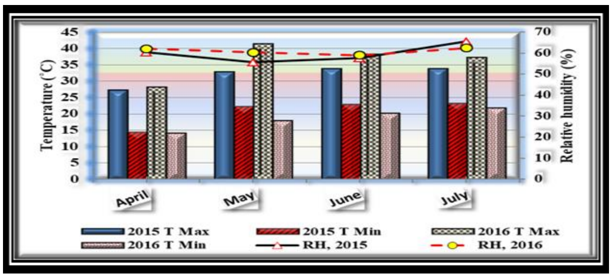


Fig. 1. The local meteorological data during 2015 and 2016 summer seasons prevailing at the region of cowpea cultivation

Statistical analysis:

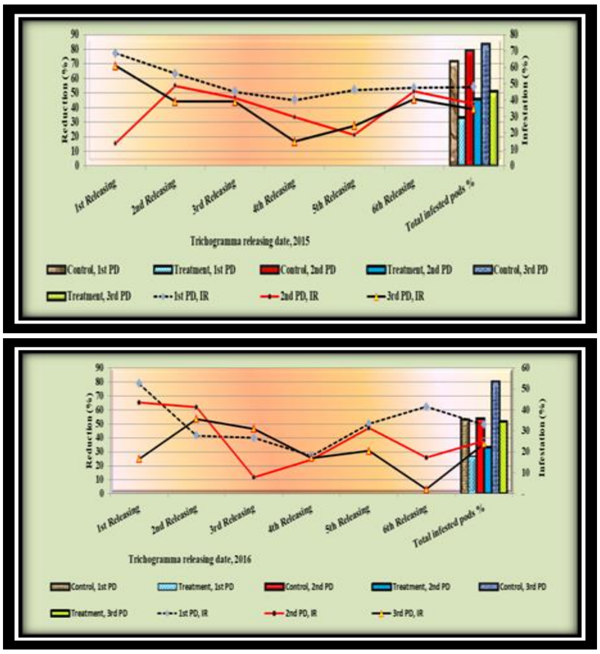
Recorded data of both seasons of 2015 and 2016 for all the studied traits were subjected to analysis according to Snedecor and Cochran, 1967 and the comparison among means was applied using Duncan Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Planting dates:

***Etiella zinckenella,* infestation:**

Results revealed that the percentage of *Etiella zinckenella* infestation on cowpea pods significantly differed according to the planting date during the two successive seasons, 2015 and 2016. The seasonal mean percentage of plant infestations were 63.5 & 35.3, 70.0& 35.5 and 74.0 & 53.3 % on 1st April, 15th April and 1st May planting date at seasons of 2015 and 2016, respectively. However, the infestation was lowest in 2nd season compared with the 1st one. Moreover, the plant infestation increased by delaying planting date (Fig.2) in both seasons. The cowpea plants were sown in the earliest planting date (April, 1st) significantly exhibited the lowest percentage (63.5% and 35.3% in 1st and 2nd season, respectively). Oppositely, the plants of the last planting date (May, 1st) showed the highest infestation (45.2 and 34.3% for 1st and 2nd season, respectively).



Planting date		1st April	15th April	1st May
T. evanescens Releasing date	1st Releasing	06-May	•	•
	2nd Releasing	15-May	15-May	•
	3rd Releasing	23-May	23-May	•
	4th Releasing	01-Jun	01-Jun	01-Jun
	5th Releasing	09-Jun	09-Jun	09-Jun
	6th Releasing	15-Jun	15-Jun	15-Jun
	7th Releasing	•	01-Jul	01-Jul
	8th Releasing	•	•	08-Jul
	9th Releasing	•	•	15-Jul
Infestation Reduction %	1st season	54.10%	42.40%	39%
	2nd season	49.53%	38.03%	35.63%

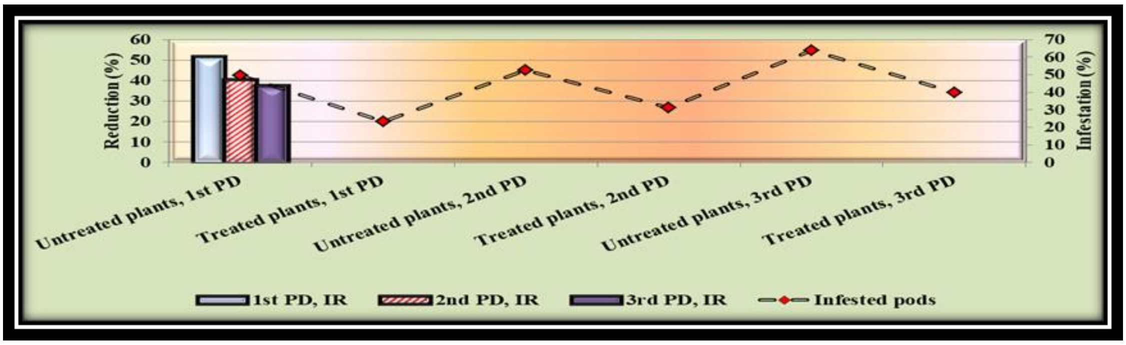


Fig.2. Schedule and Effect of *T. evanescens* release (30,000 wasps/feddan) for controlling of *E. zincknella* in cowpea fields, at three planting dates (PD) during 2015 and 2016 seasons (Upper) and average of both seasons (Down).

These results are agreement with the findings of Helaly *et al*., (1990), Ekesi *et al*. (1996), Helalia *et al.* (2011) and Shaalan (2016). They stated that the population density of pod-borer and plant infestations were significantly affected by the planting date and the early plantation could be involved in reducing E. zinckenella infestation and subsequently increase the cowpea yield.

Schedule and efficacy of *Trichogramma evanescens* release:

The parasitoid was released six times at rate of 30,000 wasps/fed for controlling of *E. zincknella* in cowpea fields, at three planting dates (PD) during 2015 and 2016 seasons and average of both seasons are shown in Fig. 2. Data show that the percentages of infested pod were in general significantly between treatment in egg-parasitoid-released plots of 29.2, 40.3 and 45.2%, respectively in 1st,2nd and 3rd planting dates in the first season while, it was 17.8, 22.0 and 34.3%, respectively in the second one. It is lower than in percent infestation pods in the experimental region as shown in previously discussion in a paragraph of *Etiella zinckenella* infestation. These results revealed that the percentage of infested pods clearly decreased after application of *Trichogramma* with about 54.1, 42.4 and 39% in the first season and about 82.3, 82 and 78.5%, in the second one at 1-April, Mid—April and 1-May, in descending order compared with the control. Similar results were obtained by Abbas (2004), Mona *et al.* (2004) and Mohamed *et al.* (2015) who found that treated with the local egg- parasitoid, *Trichogramma evanescens* at rate of 30000/fed resulted in low pod infested and having no adverse effect on beneficial species (parasites and predators) and having non-toxic to man, plants and animals.

Cowpea traits:

The results obtained in Table 1 showed that there are significant differences due to different sowing dates on cowpea vegetative characteristics in both seasons. Both plant height and number of branches per plant were positively affected by early sowing dates. The first date (1st April) gave the heighest values of both traits followed by 15th April and 1st May in descending order. On contrary, the third planting date exhibited the lowest values in both seasons. These results may be due to convenience of dominated climatic factors during this planting date for growth of cowpea plants (Delouche, 1980). Also, Tawaha and Turk (2002) stated that lentil plant heights, primary and secondary branches /plant were reduced by sowing dates delaying.

Firstly, it is worthy to notice that plant height and branches values in the second season were higher than in the first one. Differences conditions in the two seasons might account much for this finding. Obtained results indicate that sowing cowpea in the 1st sowing date (April, 1) gave the tallest plants and more number of branches (Table 1) with no significant differences between the 1st and 2nd planting dates for number of branches. This finding is true in both seasons. Delaying sowing date from the potent sowing date treatment (April, 1) to mid-April and 1st May decreased height of plants in the 1st season by 7.2 and 15.8% and sharply decreased in the 2nd season by 14.7 and 35%, respectively, branches decreased by 23.9% and 6.3% in the 1st and 2nd one, respectively when delaying sowing date from 1st April to 1st May. However, no significant differences were observed between the 1st and 2nd sowing dates in branches at 2nd season.

Climatic conditions (Fig.1) prevailing the 1st sowing date (April, 1) furnished favorable conditions to produce healthy taller plants having more branches. Kondra (1975) reported that later sown crops yield less than earlier sown. He added that this may be due to the higher temperature during development of the later sown plants will cause a more rapid rate of leaf death and reduce canopy, this will affect the supply of photosynthate to the plant and may account for the lower seed yield of the later sown plants. EL-Metwally *et al.* (2013) and Hegab *et al.* (2014) found that the highest values of vegetative characters of were obtained at the early sowing date. This was attributed to differences between day/night predominate temperature during plant growth.

Concerning the effect of different sowing dates on yield and its components presented in Table 1, significant differences among the sowing dates for all studied yield traits, *i. e.*, No. of pods/plant, No. of seeds/ pod, Seed index (100-seeds wt., gm) and Dry seed yield /fed (kg) were observed. First sowing date (1st April) gave the highest yield and its components followed by second sowing date (mid April) and third one (1st May) in descending order. However, there are insignificant defferences between 1st and 2nd plantig dates in both number of pods per plant and dry seed yield in both seasons.

Table 1. Vegetative, germination, yield and its attributes, seed constituents and protein content as affected by planting dates and nitrogen levels with utilization of *T. evanescens* releasing on cowpea plants at 2015 and 2016 summer seasons.

Tested qualities and components	Item	1st Season			2nd Season		
		Planting dates:					
		1st April	15th April	1st May	1st April	15th April	1st May
Vegetative traits	PH (cm)	50.50^{a}	46.88^{b}	42.50^{c}	71.24^{a}	60.74^{b}	46.33^{c}
	NBP	6.11^{a}	5.75^{a}	4.65^{b}	5.91^{a}	5.90^{a}	5.54^{b}
Yield and its attributes	NPP	29.35^{a}	26.24^{b}	21.82^{c}	30.34^{a}	28.47^{b}	22.41^{c}
	NSP	9.91^{a}	9.45^{b}	8.04^{c}	10.22^{a}	9.66^{b}	8.82^{c}
	100SW	21.95^{a}	21.63^{b}	20.41^{c}	23.05^{a}	22.03^{b}	21.09^{c}
	DSY/fed	861.9a	847.97a	772.93b	882.93a	836.3a	767.53b
Germination traits	G (%)	90.44^{a}	88.88^{b}	83.33^{c}	91.67^{a}	90.33^{b}	84.56^{c}
	GR	2.0^{a}	2.1^{b}	2.1^{b}	1.9^{a}	2.0^{b}	2.1^{c}
	SL (cm)	32.97^{a}	31.33^{b}	30.13^{c}	65.17^{a}	38.40^{a}	32.32^{a}
Seeds constituents	N (%)	3.97^{a}	3.82^{b}	3.61^{c}	4.01^{a}	3.91^{b}	3.68^{c}
	P (%)	0.123^{a}	0116^{ab}	0.110^{b}	0.123^{a}	0.116^{a}	0.116^{a}
	K (%)	1.473^{a}	1.443^{b}	1.410^{c}	1.486^{a}	1.440^{b}	1.417^{c}
Protein	Pr.%	24.79a	23.88b	22.60c	25.08a	24.46b	23.02c
		Nitrogen levels:					
		100%	50%	Control	100%	50%	Control
Vegetative traits	PH (cm)	53.50a	45.88b	42.50c	65.07a	56.55b	53.35c
	NBP	6.17a	5.28a	4.42b	6.73a	5.33b	4.28c
Yield and its attributes	NPP	32.82a	26.65b	14.94c	33.84a	28.21b	15.84c
	NSP	10.61a	9.92b	6.71c	10.98a	10.43b	7.21c
	100SW	23.58a	22.39b	17.69c	24.52a	23.05b	18.27c
	DSY/fed	1032.7a	863.87b	586.23c	1038.03a	875.23b	573.5c
Germination traits	G (%)	93.11a	90.22b	79.33c	94.13a	91.77b	80.67c
	GR	1.93^{a}	2.0^{b}	2.2^{c}	1.83^{a}	1.93^{b}	2.17^{c}
	SL (cm)	35.27^{a}	34.74^{b}	24.44^{c}	36.5^{a}	35.57^{a}	26.3^{a}
Seeds constituents	N (%)	4.16^{a}	3.90^{b}	3.35^{c}	4.33^{a}	3.99^{b}	3.28^{c}
	P (%)	0.123^{a}	0.113^{a}	0.113a	0.126a	0.120ab	0.110b
	K (%)	1.516^{a}	1.41^{b}	1.396^{c}	1.53^{a}	1.41^{b}	1.40^{c}
Protein	Pr.%	26.0^{a}	24.40^{b}	20.9^{c}	27.1^{a}	24.94^{b}	20.52^{c}

Values within the same column followed by the same letters are not significantly different, using Duncan's Multiple Range Test at 5% level

The lowest traits values were obtained by third sowing date (1st May). Superiority of 1st April (PD_1) sowing date treatment in these traits may be resulted from their obvious increase invegetative growth traits i.e. plant height (Table 1), In this respect, Zein *et al*. (2004) stated that the early planting gave the highest biological and seed yields due to the favorable environmental conditions to germination seeds and long growing season. As well, Tawaha and Turk (2001) indicated that shorter growing period (lately sowing date) might result in less dry matter accumulated and fewer pods per plant which reduced seed yield. Also, similar findings were reported by Turk and Tawaha (2002), Khalil *et al*. (2011), Getachew *et al.* (2014), Abdul–Waheed *et al.,* (2015) and Nikam *et al.* (2018). They reported that the environment conditions such as temperature during seed development (at the time of pod maturity) is a major determinant of seed yield and there are a significant increase in the seed yield and its components of plants as expressed by seed yield and green pods /fed, number of green pods /plant, number of seed /pod (Siddique *et al*., 2002; Gabr *et al*., 2007; Getachew *et al*., 2014; Abdul–Waheed *et al*., 2015 and Nikam *et al*., 2018). As for the germination traits (percentage, rate and seedling length), data showed significant differences among the sowing dates for these traits in both seasons except seedling length in 2nd season in which no significant differences among the three planting dates. First sowing date (1st April) gave the highest germination percentage and seedling length at both seasons and germination rate in 2nd one followed by second sowing date (mid April) and third one (1st May) in descending order. There was poor germination for the third planting dates. The 1st and 2nd planting dates resulted in significant improvement in germination. The poor germination observed in 3rd planting dates could be attributed to the occurrence of dry spell that are characteristics of the agro ecological zone (Alidu, 2019). The analysis of cowpea seeds in Table 2 showed that there were significant differences in the major (NPK) nutrient concentrations due to different sowing dates in both seasons except phosphorus in which no significant differences among the three dates at 2nd season. The 1st date of sowing gave the highest nitrogen, phosphorus and potassium followed by the second date in both seasons with no significant differences between the 1st and 2nd planting dates for phosphorus in 1st season. While, the lowest nitrogen, phosphorus and potassium contents was noticed from the third planting date. Such results were reported by Olness *et al*. (1990) who found that delayed planting required time to reach maximum N accumulation rates. Moreover, the production of seeds with satisfactory protein content is extremely important in cowpea, as this legume is one of the main components of the diet of developing countries, especially in rural areas. Generally, the crude protein content obtained in the 2016 growing season, On average, was higher than that obtained in 2015, possibly due to the most favorable weather conditions that in turn favored the development of the plants and seed filling, providing the seeds with a higher crude protein content (Table 1). However, the presented data indicate that the protein content was significant affected with the difference of sowing dates. The highest seed protein content of cowpea seeds was obtained by sowing on 1st date (1st April) followed by 2nd one in the two seasons. On the other hand, the lowest value of protein content recorded with third sowing date of both seasons.

Nitrogen levels:

Data obtained in Table 1 indicate that nitrogen fertilization with full recommended doses (100%) significantly increased vegetative traits (PH & NBP) at both seasons with significant differences between 100% and 50% for NBP in 1st season. In contrast, the lowest values of both characters were obtained from 50% N /fed. The positive results of the added N effects may be due to the important role of nitrogen and its vital contribution to several biochemical processes in the plant related to growth and to its role in assimilating the photosynthetic reaction. These results agree well with those obtained by El-Bably and El-Waraky (2006) and El-Waraky and Kasem (2007). As for yield and its components, data revealed that nitrogen fertilization with full recommended doses (100%) significantly increased NPP, NSP, 100-SW and DSY/fed in both seasons as compared with the low N level or the untreated control of 100% N without biological insects control (without *Trichogramma* release). However, The obtained increments in the seed yield as a result of N. application might be directly attributed to the increase in pod number per plant, number of seeds/pod and 100-seed weight. These results seemed to be in accordance with those reported by Hussaini *et al*., (2004) and El-Waraky (2007). They found that the soil application of N at the rate of 40 or 60 kg fed gave the highest mean values of pea dry seed yield, also, reported that the increase in seed yield was related to the increments on number of pods plant rather than that to increase in weight of seeds pod and explained the increase in seed yield, as a result of N fertilization, on the basis that the pollen produced by plants with high nitrogen treatment sired significantly more seeds than pollen produced from low nitrogen dose. Regarding to germination traits (percentage, daily rate and seedling length), seed constituents (N, P and K) and protein content, there are significant differences between the three nitrogen treatments for these traits in both seasons except for phosphorus content and seedling length among the three N treatments at 1st and 2nd season, respectively as well as between 100%N and 50% N under *Trichogramma* release for phosphorus in 2nd season. Full recommended nitrogen dose (100% N) with bio-control exhibited the highest values for all abovementioned traits in both seasons. These results were in according with Gaber *et al.* (2007), Narits (2010) and Fouda *et al*. (2017) who referred that NPK% with compost treatments were resulted in a significant increase in nitrogen, phosphorus and potassium contents in leaves and seeds of bean plant. In addition to, seed content of carbohydrate % and protein% also increased and also, it is the basis for proteins in plants, nitrogen present in the chloroplasts, which are the molecules within plants that perform photosynthesis, making food. If plants do not have enough nitrogen, it turns yellow in part because the chloroplasts are not functioning properly.

Interaction between sowing dates and nitrogen levels

Fig. 3 showed significantly interaction effect between sowing dates and nitrogen rates on vegetative growth parameters (plant length and number of branches). The highest plant length, number of branches were obtained by first sowing date and application of 100% nitrogen recommended dose, followed by 2nd planting date with the same level of 100% N with *Trichogramma* release. While, the lowest values were obtained by therd sowing date and 100% nitrogen without *Trichogramma* release. Nitrogen fertilizer is a macronutrient of all plants which need to integral component of amino nucleic acids, proteins, nucleotides, chlorophyll, chromosomes, genes and ribosome as well as a constituent of all enzymes. This wide range of different nitrogen containing plant compounds explains the important role of nitrogen for plant growth (Blumenthal *et al*., 2008). If plants do not have enough nitrogen, it turns yellow in part because the chloroplasts are not functioning properly (Narits, 2010). As for yield and its attributed traits (Fig. 3), the components of yield contained number of pod /plant, number of seed /pod, seed index (100 seed weight) and dry seed yield/feddan under same agro-climatic conditions of cwopea plants. Data presented in the same Fig. 3, showed clearly the positive effect of the interaction between sowing dates and nitrogen doses on number of pods /plant, number of seeds /pod, weight of 100-seeds (seed index) and seed yield/feddan.

The highest number of pods plant-1, number of seeds pod-1, weight of 100 seeds and seed yield Feddan-1 were resulted by first date of sowing seeds and 100% N. while, the lowest values were obtained by third date of sowing and application 100% N without insect control.

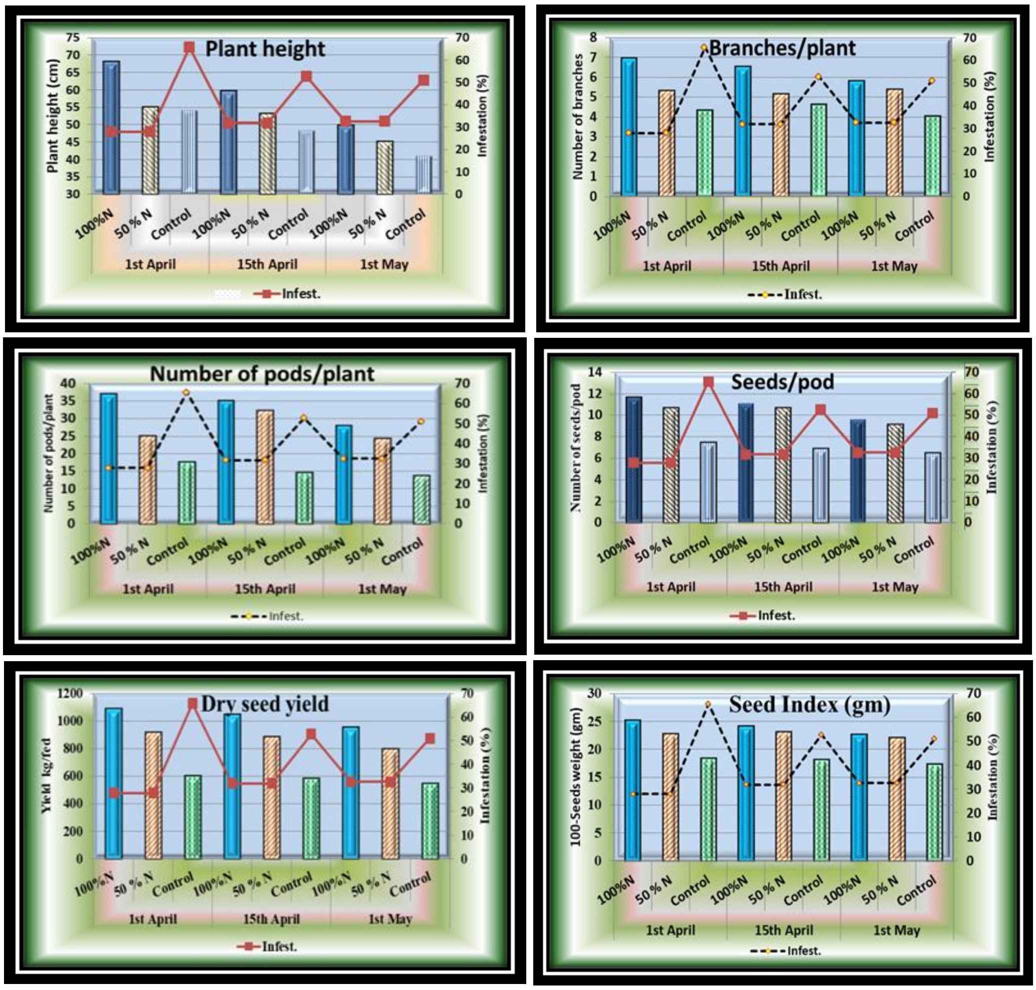


Fig. 3. Plant height and branches number as well as yield and its attributes as affected by planting dates and nitrogen levels interaction in relation to *T. evanescens* releasing for controlling of *E. zincknella* (average of both seasons)

Also, the presented data in Table 2 showed clearly positive effect of the interaction between sowing dates and nitrogen doses on seed germination, germination rate and seedling length. The highest number of seed germination, germination rate and seedling length were resulted by the seeds harvested from the first sowing date and 100% N under releasing *Trichogramma evanescens*. On the contrrary, the lowest values were obtained by third date of sowing seeds and N without bio-control. The results are in line with Kakon *et al.* (2015) who reported that the germination percentage and vigor index of harvested seed was also significantly influenced by higher doses of N and P while the lowest seed quality from plants that received no fertilizer in both the years. Interaction between sowing dates and nitrogen doses in the same Table showed a difference in seed nutrient and protein concentrations. The highest concentration of N, p and K contents was obtained by application of 100% nitrogen dose with the 1st date under *Trichogramma* treatments in both seasons. But the lowest concentrations found with corresponding control of the three planting dates (any dates without bio-controlled). These results are in agreement with the findings to Gabr *et al.* (2007). Seed protein content % was significantly affected by the application of different nitrogen rates in early planting dates (Stevovic *et al.*, 2003 and Gul *et al.*, 2006). Generally, the first planting date interacted with 100% N under field of Trichogramma releasing was superior for vegetative growth characteristics, seeds/ pod, number of pods /plant, as well, increasing the seed yield per feddan and all studied traits.

Accordingly, comparing the performance of Kafr El-Sheikh cv through six treatments (three planting dates × two nitrogen levels) on the basis of total yield (kg/fed) and highest desirable increment of yield (% over the general mean of control treatment under natural infestation stress) as well as the performance of other traits was done. The best treatments, which classified on the basis of these parameters, are shown in Table 3.

Five out of the 6 studied treatments (3-PD×100% N_T & both 1st and Mid-April× 50% N_T) were classified as the heaviest treatments for yield (>50% significant increase) and exhibited more significant increase for NP/P, NS/Pd and Protein comparing general control (100%N_T of 1st planting date) in addition to surpassing the general average for most traits. Two out of these five treatments namely: 100%N_T × 1st April and 100%N_T × Mid-April recorded the highest desirable positive increment and superior for number of branches, germination percentage, seedling length (cm) and seed index (g/100-seeds weight) comparing with the control and other treatments, indicating the possibility of combine both high yield and good quality characters by chosen the best planting date with *Trichogramma* releasing in limited times. The five treatments, which exhibited significant positive increment for yield/plant, were also combined significant/highly significant desirable negative or positive (due to the point of view) three or more important studied characters particularly vegetative growth, average tuber weight ….*etc*. Our results reveal that the abovementioned treatments might be of prime importance for traditional agricultural procedures for high yield and/or some of its important components under *E. zenckenella* infestation in north Egypt.

Table 2. Vegetative, germination, seed constituents and protein content as affected by planting dates and nitrogen levels interaction with utilization of *T. evanescens* releasing on cowpea plants at 1st S (2015) and 2nd S (2016) summer seasons.

Tested qualities and components	Item	Season	1st April			15th April			1st May		
			100% N_T	50 % N_T	Contr.	100% N_T	50 % N_T	Contr.	100% N_T	50 % N_T	Contr.
Germination traits	G	1st S	96.3^{a}	94.0^{b}	81.0^{f}	95.0^{b}	92.3^{c}	79.3^{g}	88.0^{d}	84.3^{e}	77.7^{h}
		2nd S	97.7^{a}	95.3^{bc}	82.0^{f}	95.7^{b}	94.3^{c}	81.0^{f}	89.0^{d}	85.7^{e}	79.0^{g}
	GR	1st S	1.8^{e}	1.9^{d}	2.2^{b}	2.0^{c}	2.0^{c}	2.2^{a}	2.0^{c}	2.1^{b}	2.2^{a}
		2nd S	1.7^{e}	1.9^{d}	2.1^{b}	1.8^{d}	1.9^{d}	2.2^{a}	2.0^{c}	2.0^{c}	2.2^{a}
	SL	1st S	37.0^{a}	36.0^{b}	25.9^{e}	35.0^{c}	34.7^{c}	24.3^{f}	33.8^{d}	33.5^{d}	23.1^{g}
		2nd S	38.5^{a}	36.6^{b}	30.1^{d}	36.3^{b}	35.7^{b}	25.0^{e}	34.7^{c}	34.4^{c}	23.8^{f}
Seeds constituents	N	1st S	4.25^{a}	4.13^{c}	3.52^{g}	4.16^{b}	4.01^{e}	3.29^{h}	4.07^{d}	3.57^{f}	3.21^{i}
		2nd S	4.41^{a}	4.33^{b}	3.30^{f}	4.39^{a}	4.05^{d}	3.30^{f}	4.21^{c}	3.59^{e}	3.25^{g}
	P	1st S	0.13^{a}	0.12^{ab}	0.12^{ab}	0.13^{a}	0.11^{b}	0.11^{b}	0.11^{b}	0.11^{b}	0.11^{b}
		2nd S	0.13^{a}	0.13^{a}	0.11^{b}	0.12^{ab}	0.12^{ab}	0.11^{b}	0.13^{a}	0.11^{b}	0.11^{b}
	K	1st S	1.52^{a}	1.45^{b}	1.45^{b}	1.52^{a}	1.41^{c}	1.40^{c}	1.51^{a}	1.38^{d}	1.34^{e}
		2nd S	1.55^{a}	1.46^{c}	1.45^{c}	1.53^{ab}	1.39^{d}	1.40^{d}	1.52^{b}	1.39^{d}	1.34^{e}
Protein	%	1st S	26.56^{a}	25.81^{c}	22.00^{g}	26.00^{b}	25.06^{e}	20.56^{h}	25.43^{d}	22.31^{f}	20.06^{i}
		2nd S	27.56^{a}	27.06^{b}	20.63^{f}	27.44^{a}	25.31^{d}	20.63^{f}	26.31^{c}	22.44^{e}	20.31^{g}

Values within the same column followed by the same letters are not significantly different, using Duncan's Multiple Range Test at 5% level N_T: nitrogen treatment with *Trichogramma* release

Table 3. The best planting date chosen on the basis of mean yield along with desirable significant responses for other traits under bio-control against *E. zenckenella* comparing with untreated control.

Time	Efficacy of *Trichogramma* release			Increment over the untreated treatment (corresponding control)							
	Infestation along the season (average of both seasons), %		Reduction (%)	Yield (kg/fed)			Range % of traits groups comparing with untreated control of 1st planting date				
	Cont	Treated plants		Cont	Bio-control 100% N_T	Bio-control 50% N_T	VT	YT	GT.	SC.	Pro
1st April	49.4	23.5	51.8	603.3	1094.4 (81.4%)	919.6 (52.4%)	25.9-60.6	37-109.8	(-)18.6-34.8	5.9-27	27
Mid- April	52.8	31.2	40.2	587.4	1052.3 (79.2%)	886.8 (51%)	10.3-51.1	31.4-98.9	(-)11.6-27.3	4.8-25.4	25.4
1st May	63.7	39.8	37.3	549	959.5 (74.8%)	802.3 (46.2%)	(-)8.1-33.8	23.5-59.4	(-)7-22.3	4.3-21.4	21.4
Mean	55.3	31.5	43.1	580	1035.4 (78.5%)	869.6 (49.9%)	a, b	c, d, e	f, g, h	i, j, k	l

Range % of the studied traits (when all three planting dates are considered under bio-control) over untreated control of 1st planting date

Item	PH (a)	NB/P (b)	NP/P (c)	NS/P (d)	SI (e)	G (f)	GR (g)	SL (h)	N (i)	P (j)	K (k)	Protein (l)
100% N	(-)8.1-25.9%	33.8-60.6	59.4-109.8	28.7-55.8	23.5-7	8.6-19	(-)18.6 – (-)7	22.3-34.8	21.4-27	4.4-13	4.5-5.9	21.4-27
50% N	(-)16.5-1.8	19.2-24.6	38.9-42.1	22.3-43.1	20.4-24.2	4.3-16.1	(-)11.6 – (-) 4.7	21.3-29.6	5-24.1	(-)4.4-8.7	(-)4.5-0.3	5-24

Cont: control without Trichogramma VT: vegetative traits YT: yield attributes traits GT: Germination traits SC: Seeds constituents Pro: seed protein % Treated plants: bio-control with Trichogramma releasing N_T: nitrogen combined with *Trichogramma* release

CONCLUSION

The results showed that the first date of planting had a positive effect on vegetative growth such as plant height, number of branches as well as seed yield and nutrient contents plant. Also, full dose of nitrogen (60 kg/ Fedd.) along with *Trichogramma* utilization at all sowing dates gave the best growth parameters as well as seed yield and resulting in:

1- To achieve higher yield, Kafr El-Sheikh cv should be planted in early April.
2- 3rd Planting date was in 1st May is not recommended for this cultivar in the experimental region.
3- It could be demonstrated that reduction of *E. zenckenella* populations by mass release of *Trichogramma evanescens* was feasible under our experimental conditions during 1st April sowing.
4- A combination of parasite releases with appropriate sowing date would be a favourable recommendation.

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تأثير ميعاد الزراعة والتسميد النيتروجينى ونسبة الاصابة بدودة قرون اللوبيا ***Etiella zinckenella,* (Treitschke)** المعاملة بطفيل الترايكوجراما ***Trichogramma evanescens* (Westwood)** على المحصول البذرى للوبيا ***Vigna unguiculata,* L.**

طارق جلال عنانى[1]* و إيناس مصطفى يحيى[2]

[1] قسم بحوث تكنولوجيا تقاوى الخضر معهد بحوث البساتين ، مركز البحوث الزراعية

[2] معهد وقاية النبات ، مركز البحوث الزراعية

تم إجراء تجربتين ميدانيتين خلال موسمين صيفي متتاليين 2015 و 2016 في المزرعة التجريبية للخضر التابعة لمعهد بحوث البساتين ، مركز البحوث الزراعية بقها ، محافظة القليوبية مصر لدراسة استجابة نباتات اللوبيا للاصابة بدودة قرون اللوبيا E. zinckenella في ثلاثة مواعيد زراعة (1 أبريل ، منتصف أبريل ، 1 مايو) وثلاثة مستويات من النيتروجين (100٪ و 50٪ من الجرعة الموصى بها معاملة بالترايكوجراما بالاضافة الى معاملة الكنترول التى كانت 100% نيتروجين بدون معاملة الترايكوجراما) وكذلك دور Trichogramma evanescens في الحد من الإصابة بالحشرات مقارنة بالكنترول على صنف اللوبيا المختبر . وقد أظهرت النتائج المتحصل عليها أن تاريخ الزراعة الأول (اول ابريل) كان له تأثير معنوي مرغوب فيه على نمو النبات والمحصول ومكوناته أي عدد البذور في القرن ووزن 100 بذرة ومحصول الفدان في كلا الموسمين . أيضا ، سجل تاريخ الزراعة الأول مع 60 كجم / فدان نيتروجين مع إطلاق *Trichogramma* أعلى صفات النمو الخضري ، صفات المحصول أعلى تركيز للنيتروجين والفوسفور والبوتاسيوم وكذلك محتوى البروتين في بذور اللوبيا. كما أعطت الاضافة الكاملة من النيتروجين (60 كجم / فدان) مع استخدام *Trichogramma* في جميع مواعيد الزراعة أفضل معايير النمو وكذلك محصول البذور . وانخفضت النسبة المئوية للقرون المصابة بشكل واضح بعد تطبيق معاملات *Trichogramma evanescens* بحوالي 54.1 و 42.4 و 39٪ في الموسم الأول وحوالي 82.3 و 82 و 78.5٪ في الموسم الثاني في 1 أبريل ومنتصف أبريل و 1 مايو ، بترتيب تنازلي مقارنة بالكنترول ومع ذلك ، لوحظت فروق معنوية في نسبة القرون المصابة بين مواعيد الزراعة الثلاثة . كما زادت الإصابة بالنبات بتأخير موعد الزراعة في الموسمين . ولاتوجد فروق معنوية في النسبة المئوية لنقص النسبة المئوية للقرون المصابة بين ميعادى زراعة اول ومنتصف ابريل لنباتات اللوبيا المعاملة بالترايكوجراما . ويمكن التوصية بإطلاق طفيل البيض *T. evanescens* مع تاريخ الزراعة المحدد في 1 أبريل للتحكم فى الاصابة بدودة قرون اللوبيا *E. zinckenella* .