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Investigation of Cowpea and Yardlong Bean for Resistance to Bean Aphids (*Aphis craccivora* Koch)

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Abstract. Four F_1 hybrids were made between yardlong bean (Selected – PSU) as a susceptible line and four lines of cowpea that had been reported as resistant lines; IT82E – 16, SR_{00} – 863, Suranaree 1, and Khao – hinson were planted in replicated plots under screenhouse conditions at the Thaksin University Thailand, between September and November 2009. The experimental design was a Randomized Complete Block Design with four replications. Five apterous adult aphids were released on each plant three weeks after germination. A number of aphids and visual scored damages were determined for each generation. The results showed that the highest number of aphids infestation were found on Selected – PSU line about 6,535.02±993.56 aphids/plant. The lowest number of aphids was recorded on IT82E – 16 line about 1,606.81±215.34 aphids/plant. The same results were obtained from visual scored damages about 4.00±0.00 and 1.67±0.17 points, respectively.

Keywords: aphid (*Aphis craccivora*), resistant line, susceptible line, yardlong bean, cowpea.

1. Introduction

Yardlong bean (*Vigna sesquipedalis* L.) is a common vegetable in Asian markets. It originated from West Africa. It is cultivated extensively in many countries in Southeast Asia such as Malaysia, Philippines, Indonesia and Thailand. This crop is also widely grown in Southern China, India and Pakistan. In Thailand, production area of yardlong bean was estimated at 18,560 – 20,160 ha annually [1]. Cowpea (*Vigna sinesis* L.) is the most important grain legume crop to be grown in Sub-Saharan Africa with greater area than other grain legumes [2]. There are at least 12.5 million hectares, with an annual production of over 3.0 million tons worldwide [3]. Cowpea is mainly grown in West Africa but substantial quantities also are grown in East, Central and Southern Africa. In addition, cowpea is a significant crop in South Asia with about 1 million ha grown in India and substantial opportunities for expanding the cropped area in this country. In Thailand, a major problem for yardlong bean and cowpea production is the severe infestation and damage by various insect pests in the field. Cowpea aphid (*Aphis craccivora* Koch.) is considered to be the most important pest of yardlong bean and cowpea [4]. The damage to yardlong bean by *A. craccivora* is caused by both adults and nymphs [5]. The aphid feeds by sucking fluid from the stem terminal shoots, petioles, flowers and pods [6]. Heavy feeding can kill young plants, otherwise it causes stunting, distortion of leaves, delay an initiation of flowers and reduces pod set in plants which survive attack [7-9]. But the most damaging effect of *A. craccivora* may be through transmission of cowpea aphid – borne mosaic virus resulting in yield loss [10-11]. Foliar application of several insecticides have been reported to be effective against *A.craccivora*. However, insecticide application is not considered to be environmentally friendly farming method. Moreover, it is harmful to human and increasing in costs of production. Reducing chemical application, resistant varieties

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should be more improved [12]. Therefore, the purpose of this study was to evaluate cowpea and yardlong beans, in order to find other sources that have resistant factors, which can be transferred towards new lines.

2. Materials and Methods

2.1. Plant materials

The four resistant lines of cowpea; IT82E – 16, SR_{00} – 863, Khao – hinson and Suranaree – 1 were crossed as males with the susceptible yardlong bean, Selected – PSU, to produce F_1 hybrids. Four F_1 hybrids and their parents were grown under the screenhouse conditions at the Department of Agricultural Technology, Faculty of Technology and Community Development, Thaksin University, Phatthalung Province Thailand, between September and November 2009. The experimental design was a Randomized Complete Block Design (RCBD) with 4 replications, each replication consisting of ten plots.

2.2. Aphids infestation

Five apterous adult aphids were released on each plant at 3 weeks after planting [13]. The conventional agronomic practices were followed to keep the crop in good condition. The actual number of aphids/plant during weeks 4 to 7 was counted and visual damage were assessed for each generation. The visual damage was scored and based on the following scale [14]

0 = visual damage on leaves and flower buds 10 %
1 = visual damage on leaves and flower buds 10-25 %
2 = visual damage on leaves and flower buds 26-50 %
3 = visual damage on leaves and flower buds 51-75 %
4 = visual damage on leaves and flower buds 76-100 %

3. Results and Discussion

3.1. Number of aphids

After releasing aphids and evaluating the number of aphids between the breed of the parents and 4 pairs of F_1 hybrids in the screenhouse, it was found that the number of aphids had increased in all groups of population and was statistically significant 4 -7 weeks after planting. After 4 weeks of planting, it was found that there was the smallest number of aphids in IT82E – 16 line which were 50.41±8.24 aphids/plant. Next was F_1 hybrids between Selected – PSU x IT82E – 16 cross, whereas the Selected – PSU line was the most susceptible to aphids which was 199.29±5.12 aphids/plant. 5 and 6 weeks after releasing the aphids it was found that the number of aphids were statistically significant as regards the resistant line and all the 4 pairs of hybrids. Especially 6 weeks after germinating, there were the highest number of aphids in Selected – PSU line which were 4,421.02±648.12 aphids/plant. IT82E-16 line resisted aphids having the smallest number of aphids which were only 1,418.02±158.14 aphids/plant. Next was F_1 hybrids between selected – PSU x IT82E – 16 corss, SR_{00} – 863 line and Khao – hinson line which had the number of aphids at 1,665.22±209.32, 2,669.15±256.49 and 2,878.80±268.44 aphids/plant respectively. As for other groups of population, there were numbers of aphids between 2,918.24±276.56 and 3,005.24±297.78 aphids/plant (Table 1) and after 7 weeks of planting, it was statistically significant between resistant and susceptible lines. This experiment is consistent in the report of Salifu et. al. [15] which studied the resistance of bean flower thrips (*Megalurothrips sjostedti*) in cowpea in Nigeria. It was found that the number of thrips had increased rapidly and it was statistically significant between susceptible and resistant lines of thrips. As for the resistance to aphid in cowpea in India, it was found that it yielded similarly. The resistant cowpea had the number of aphids/plant and the weight per 10 aphids less than susceptible line. Besides, it was found that aphids in resistant cowpea had formed in smaller groups than in susceptible cowpea. [16-17]

3.2. Visual scored damages

Four weeks after planting, selected-PSU line had the highest intensive level of destruction which was 1.44±0.14 points, while cowpea line IT82E – 16 had the lowest intensive level of destruction at 0.09±0.01 points. Next was F_1 hybrids between Selected – PSU x IT82E – 16 cross which had intensive level of destroying of aphid at 0.27±0.01 points. As for 5 and 6 weeks after releasing aphid, it was found that Selected – PSU line had the highest intensive level of destroying at 3.05±0.34 and 3.41±0.45 points respectively; whereas, line IT82E – 16 line which resisted the aphids had intensive level of destroying of

aphids at 1.20±0.05 and 1.61± 0.11 points respectively. 7 weeks after planning, it was found that Selected – PSU line had intensity level of destroying of aphids at 4.00±0.00 points (maximum points). As for the population from other groups, the average was from 1.67±0.17 – 2.58±0.30 points which all of 4 parental lines and all pairs of hybrid had intensity destroyed level of aphid less than Selected – PSU line (Table 2). The increase of destructive level of aphids was consistent in the increase of aphids in Selected – PSU line which had destruction level of aphid higher than parental lines and F_1 hybrids of every pair of hybrid. As a result, the evaluation of the resistance of aphid can be predicted from the number of aphid or the destructive level of aphid. [18]

Table 1: Number of aphids on yardlong bean, cowpea and their F_1 hybrids between 4 and 7 weeks after germination.

Lines	weeks after planting (Mean ± SE)			
	4 weeks	5 weeks	6 weeks	7 weeks
Selected – PSU	199.29 ± 5.12	1456.0 ± 243.61	4,421.02 ± 648.12	6,535.02 ± 993.56
IT82E – 16	50.41± 8.24	247.82 ± 68.45	1,418.02 ± 158.14	1,606.81± 215.34
SR_{00} – 863	103.33 ± 10.35	734.61 ± 105.41	2,669.15 ± 256.49	2,998.84 ± 321.48
Khao – hinson	148.34 ± 11.87	747.33 ± 136.43	2,878.80 ± 268.44	3,001.25 ± 335.46
Suranaree 1	154.71 ± 12.78	787.73 ± 152.14	2,918.24 ± 276.56	3,021.30 ± 346.86
F_1(Selected – PSU x IT82E – 16)	77.62 ± 9.31	536.57 ± 89.13	1,665.22 ± 209.32	1,959.73 ± 289.45
F_1(Selected – PSU x SR00 – 863)	106.01 ± 13.53	785.84 ± 115.42	2,954.60 ± 267.51	3,034.07± 349.52
F_1(Selected – PSU x Khao–hinson)	165.65 ± 14.51	801.12 ± 145.25	2,991.29 ± 281.74	3,045.57 ± 353.15
F_1(Selected – PSU x Suranaree 1)	168.08 ± 14.13	814.07 ± 153.53	3,005.24 ± 297.78	3,140.05 ± 361.62
F – test	**	**	**	**
$LSD_{0.01}$	10.45	403.61	1009.82	1694.27
CV. (%)	10.18	12.96	14.14	16.73

** Showed significantly different between generations by Least Significant Different (LSD) test, p = 0.01

Table 2: Visual damage scored on yardlong bean, cowpea and their F_1 hybrids between 4 and 7 weeks after germination.

Lines	weeks after planting (Mean ± SE)			
	4 weeks	5 weeks	6 weeks	7 weeks
Selected – PSU	1.44 ± 0.14	3.05 ± 0.34	3.41 ± 0.45	4.00 ± 0.00
IT82E – 16	0.09 ± 0.01	1.20 ± 0.05	1.61 ± 0.11	1.67 ± 0.17
SR_{00} – 863	0.43 ± 0.03	1.78 ± 0.11	1.92 ± 0.22	2.03 ± 0.26
Khao – hinson	0.54 ± 0.04	1.96 ± 0.12	1.94 ± 0.23	2.44 ± 0.30
Suranaree 1	0.59 ± 0.13	1.98 ± 0.18	1.96 ± 0.24	2.57 ± 0.30
F_1(Selected-PSU x IT82E – 16)	0.27 ± 0.01	1.50 ± 0.10	1.85 ± 0.16	1.72 ± 0.19
F_1(Selected-PSU x SR_{00} – 863)	0.53 ± 0.05	1.79 ± 0.12	2.13 ± 0.20	2.23 ± 0.30
F_1(Selected-PSU x Khao-hinson)	0.55 ±0.05	1.97 ± 0.16	2.20 ± 0.26	2.56 ± 0.30
F_1(Selected-PSU x Suranaree 1)	0.60 ± 0.14	1.99 ± 0.20	2.33 ± 0.28	2.58 ± 0.30
F – test	**	**	**	**

$LSD_{0.01}$	0.58	0.75	0.68	0.92
CV. (%)	5.21	7.91	9.04	10.57

** Showed significantly different between generations by Least Significant Different (LSD) test, p = 0.01

4. Conclusion

As from the comparison of the number of aphid destroying parental lines and all F_1 hybrids in screenhouse conditions, it was found that the number of aphids increased in every group of generation, especially in Selected – PSU line which was susceptible to aphids. There was a highest number of aphids/plant every week which was consistent with the destroying level of aphid which Selected – PSU line has the highest value. Especially, after planting for 7 weeks, it was found that the points of destroying level of aphid in Selected – PSU were 4.00±0.00 points, while resistant line and F_1 hybrids in every pair had destroying level of aphid less than Selected – PSU line.

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