

Efficacy of Garlic and Chili Combination Solution on Cabbage Insect Pests and Crop Growth in Vietnam

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Abstract—The study was conducted to evaluate the efficiency of Garlic and Chili combination solution on control of insect pests in cabbage crop. The solution was sprayed at different intervals after transplanting. The efficiency of Garlic and chili combination solution on cabbage insect pests was measured. Results revealed that Garlic and chili combination solution was the effectively reduced cabbage insect pests. On other hand, the spray solution not only reduced the number of days required for the cabbage growth but also greatly enhanced the leaf number, head diameter, head weight, and quality of cabbage. Garlic and chili combination solution have positive effects on pests reduction and improve growth, yield and quality of cabbage vegetable.

Keywords—Cabbage, Garlic, Chili, Diamondback moth, Cutworm, Flea Beetle, Quality.

I. INTRODUCTION

THE vegetables are high yielding and provide nutritional security, more employment, more cash and foreign exchange [9]. Cabbage (*Brassica oleracea* L.), a member of *Cruciferae* and a useful vegetable, belongs to the genus *Brassica*. Cabbage and is related to turnips, cauliflowers and brussels sprout [6]. The Food and Agricultural Organisation [5] has identified cabbage as one of the top twenty vegetables and an important source of food globally. It has been domesticated and used for human consumption since the earliest antiquity [7], and now Cabbage is one of the most popular vegetable being grown globally in more than 90 countries [13]. Cabbage crop is much preferred by the growers because of assured yield and transportable capacity [13]. Cabbage is a rich source of vitamin A and C. The green outer leaves of cabbage are richer in vitamin A, calcium and iron than the white inner leaves. Headed cabbage are usually consumed as a cooked vegetable, or eaten fresh as an ingredient of coleslaws and mixed salads.

The crop is grown worldwide under 3 mha. The chief constraints in the production of cabbage is pest complex right from germination till harvest. The most important pest species of these and other brassica crops is the diamondback moth

Plutella xylostella (L.) [8], *Plutella xylostella* (Linnaeus) (Lepidoptera: *Plutellidae*), cabbage white butterfly, *Pieris rapae* L. (Lepidoptera: *Pieridae*), cluster caterpillars, *Spodoptera litura* F. (Lepidoptera: *Noctuidae*), beet armyworm, *Spodoptera exigua* Hübner (Lepidoptera: *Noctuidae*), the green peach aphid, *Myzus persicae* Sulzer (Hemiptera: *Aphididae*), and turnip aphid, *Lipaphis erysimi* Kaltenbach (Hemiptera: *Aphididae*) [10]. Yield loss attributed to DBM can be as high as 100% [14], [15]. Global cost of control and yield loss attributed to DBM has recently been estimated between US\$ 4 and 5 billion per annum [16].

Moreover, Brassica crops are of particular importance in peri-urban environments and high farm gate prices have led to the frequent overuse of insecticides. The situation is most acute in the sub-tropics and tropics, where farmers often grow crops continuously and apply mixtures of insecticides on a weekly or sub-weekly basis. Insect parasitoids are active in fields despite the heavy use of chemical insecticides in the crop systems over the years. Overuse of pesticides has led to resistance [2], [1], crop residue problems, environmental contamination and destruction of indigenous natural enemies. The frequent application of mixtures of pesticides also has a considerable impact on the profit margins of growers.

However, biological control represents more sustainable alternatives to chemical control of cabbage insect pest; they are urgently required and are potentially more economic. A number of Bt and NPV products were reported to have high efficacy in killing the target pests with no side effects on the beneficials [11], [12]. Generally, the use of botanical insecticides is more sustainable and has a lower environmental impact than synthetic insecticides [17]. However, current commercially extracted botanical insecticides such as pyrethrum and azadirachtin tend to be relatively expensive and difficult for most smallholder farmers to obtain. To constitute a viable technology for most of the world's poor farmers, botanical insecticides must be based on plant materials that are cheap and readily available and be simply prepared rather than requiring organic solvents and complex apparatus. Further, extracts need to be benign to natural enemies in order to avoid secondary and resurgent pests, as well as having low phytotoxicity and protecting yields. Additionally the information about response of cabbage vegetable by application of Garlic and chili solution in combination to control cabbage insect pests is so far lacking. The Present study was carried out to evaluate the effect of Garlic and chili combination solution on insect pests and cabbage growth under field condition.

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II. MATERIALS AND METHODS

A. Plant Materials and Treatment Design

The experiment was carried out in Thai Nguyen University of Agriculture and Forestry, Vietnam from 2009 to 2010 in winter-spring. The experiment consists of three treatment including the control was design in Randomized Complete Block Design (RCBD) with three replicated. The cultivar used was KKcross and was transplanted at 40 x 50 cm spacing. Each plot consisted of one hundred and five plants. The Garlic and chili combination solution was sprayed at 15, 35 and 45 days after transplanting in the afternoon with a truck-mounted motorized sprayed until dripoff.

1) Garlic Bulb Extract

The outer layers of the matured garlic were peeled off. 200 g of garlic were mixed with 1 L of water and ground with a blender to obtain garlic juice. This juice was thoroughly mixed with additional 1 L of water. The mixture was then sieved to obtain a uniform extract.

2) Chilli Fruit Extract

The matured chilli fruit was used to extract. 200 g of chilli were mixed with 1 L of water and ground with a blender to obtain chilli juice. This juice was thoroughly mixed with additional 1 L of water. The mixture was then sieved to obtain a uniform extract.

3) Soap

Omo soap made of Unilever Company was used in this study.

B. Data Collection

Twenty plants per plot were selected randomly for taking observation regarding growth, and quality, time of pre-head initiation, time of head formation, and time of head maturity were recorded. Numbers of leaves per plant were obtained by counting each green and functional leaf that existed on the plant at each sampling. Head diameter was measured across the widest part of head. Average head weight was determined to kilograms per head by weighing. The efficiency of Garlic and chili combination on cabbage insect pests was measured by method of [3].

In heads of Cabbage vegetable ascorbic acid, known as vitamin C, was measured by classical titration method using 2,6-di-chlorophenol indophenol solution in mg/100g sample [4].

C. Statistical Analysis

The data obtained from the study were analyzed using SAS 9.1 statistical software for each cultivar separately. The least significant difference was calculated following a significance F-test (at $p \leq 0.05$)

III. RESULTS AND DISCUSSION

A. Effect of Garlic and Chili Combination Solution on Period Growth of Cabbage Vegetable

Growth is function of various vegetative characters put together namely, height of plant, number of leaves, plant spread, no of secondary head, days to central head formation, days to secondary head formation, head size and harvest duration. From the results obtained in Table I revealed that the time of cabbage growth was significantly different among treatment. The minimum period of pre-head initiation was found in early winter-spring with value of 24.08 days after transplanting by sprayed Garlic and chili combination + soap 0.1%, followed by mid winter-Spring, Later Winter-spring with value of 24.78 and 24.84 days, respectively, whereas the maximum period of pre-head initiation was recorded in untreated control. For the period of head formation, there were significant differences among treatments concerning it (Table I). In which, the control treatment was found to have the highest value of 43.56, 42.69 and 41.86 days after transplanting in early winter-spring, mid winter –spring and later winter-spring, respectively, whereas the period of head formation was hastened due to application of Garlic and chili combination + soap 0.1%. Moreover, the earliest harvestings were obtained by sprayed Garlic and chili combination + soap 0.1% with value of 91.38, 90.38, and 90.18 in early winter-spring, mid winter spring and late winter-spring, respectively (Table I). It seems that application of Garlic and chili combination + soap 0.1% treatment reduced the number of days required for the initiation of pre-head. This has also resulted in the earliness in the formation head and maturity of head.

TABLE I
EFFECT OF GARLIC AND CHILI COMBINATION SOLUTION ON THE GROWTH OF CABBAGE VEGETABLE¹

Treatment	Early winter spring			Mid Winter spring			Late Winter spring		
	Pre-head period	Head formation period	Head maturity period	Pre-head period	Head formation period	Head maturity period	Pre-head period	Head formation period	Head maturity period
Control	25.14a	43.56a	93.51a	26.06a	42.69a	92.43a	26.13a	41.86a	91.43a
Soap 0.1%	24.33b	43.02ab	91.26b	24.97b	41.58b	91.38b	25.83b	41.05ab	90.94b
Garlic and Chili combination solution + soap 0.1%	24.08b	41.41c	91.38b	24.78b	40.48c	90.38c	24.84c	40.21b	90.18c

1. Mean in each column followed by the same letters are not significantly different at $P \leq 0.05$ according to Duncan's multiple range test

B. Effect of Garlic and Chili Combination Solution on Quality Parameters of Cabbage Vegetable

1) Number of Leaf Per Plant

The results summarized in Table II showed that, the application of Garlic and chili combination solution + soap 0.1% had significant different effects on number of leaf per

plant. In which, the highest value was found in mid winter spring by sprayed Garlic and chili combination solution + soap 0.1%, followed by in late winter spring, early winter spring with value of 29.68, 28.21 and 27.25 number of leaf per plant, respectively as compared to untreated control.

TABLE II
EFFECT OF GARLIC AND CHILI COMBINATION SOLUTION ON PARAMETER AND QUALITY OF CABBAGE VEGETABLE¹

Treatment	Early winter spring				Mid winter spring				Late winter spring			
	Number of leaf/plant (leaf/plant)	Head diameter (cm)	Head weight (kg)	VitaminC (mg/100g)	Number of leaf/plant (leaf/plant)	Head diameter (cm)	Head weight (kg)	VitaminC (mg/100g)	Number of leaf/plant (leaf/plant)	Head diameter (cm)	Head weight (kg)	VitaminC (mg/100g)
Control	24.27c	37.0c	0.75c	22.74c	27.82c	42.41c	0.90c	24.01c	25.53c	38.92c	0.81c	23.28c
Soap 0,1%	25.71b	45.48b	0.83b	23.15b	28.34b	51.90b	1.0b	24.95b	26.56b	47.84b	0.89b	24.71b
Garlic and Chili combination + soap 0.1%	27.25a	68.20a	1.60a	25.66a	29.68a	74.39a	1.92a	26.82a	28.21a	70.71a	1.72a	25.36a

1. Mean in each column followed by the same letters are not significantly different at $P \leq 0.05$ according to Duncan's multiple range test.

2) Head Diameter and Head Weight

As can be seen from Table II, the treatment that sprayed with Garlic and chili combination solution + soap 0.1% produced the maximum head diameter 74.39 cm, 70.71 cm and 68.20 cm in mid winter spring, late winter spring and early winter spring, respectively, whereas the control treatment produced the least of head diameter in all treatment. It can be seen that the head diameter of cabbage was significantly influenced ($p \leq 0.05$) by application of Garlic and chili combination solution + soap 0.1%

For the head weight, data in Table II showed that there was significant head weight among treatments. In mid winter spring, application of Garlic and chili combination solution + soap 0.1% resulted the greatest head weight (1.92kg), followed by application of Soap 0.1% with value of 1.0 kg, whereas the lowest head weight (0.9kg) was obtained for untreated control. It is also clear from the results that application of Garlic and chili combination + soap 0.1% showed the higher head weight as compared to untreated control. This result was achieved in the late winter spring and early spring, respectively with the significantly difference at ($p \leq 0.05$). It can be seen that application of Garlic and chili combination + soap 0.1% greatly improve some parameter and quality of Cabbage vegetable compared to control treatment.

3) Vitamin C

The Vitamin C of Cabbage vegetable were significantly ($p \leq 0.05$) influenced by application of Garlic and chili combination + soap 0.1% in early winter-spring, mid winter spring and late winter spring. Data in Table II indicated that the highest value of Vitamin C 26.82mg/100g in mid winter spring, 25.66mg/100g in early winter spring, and 25.36 mg/100g in late winter spring was achieved in Garlic and chili combination + soap 0.1% sprayed, while the untreated control gave the lowest value of 24.01mg/100g, 22.74mg/100g and 23.28mg/100g, respectively.

C. Effect of Garlic and Chili Combination Solution on Control Cabbage Insect Pest

Insects from three major orders (Diamondback moth, Cutworm and Flea Beetle) were found associated with the cabbage crop. As showed in Table III, the highest value (62.03%) was obtained with Garlic and chili combination solution + soap 0.1%, followed by Soap 0.1% sprayed with value (8.26%), compared to lowest value of 0.0% was found in untreated control in the case of Diamondback moth after sprayed 5 days. Moreover, for Cutworm application of Garlic and chili combination + soap 0.1% exhibited the maximum efficiency (56.55%), but untreated control gave the lowest value of 0.0%. In the same table data showed that, sprayed Garlic and chili combination + soap 0.1% recorded the maximum value of 88.16%, while the minimum value of 0.0% was obtained in untreated control, which was found in the case of "Flea Beetle" insect pest (Table III). It can be seen that sprayed Garlic and chili combination + soap 0.1% greatly efficiency in control insect pest cabbage vegetable as compared to untreated control, which is in accordance with the finding of [11], [12].

Plant extracts are known to possess toxic organic poison that is effective in reducing insect pest population [21]. Moreover, several authors have shown the efficacy of different plant materials as biopesticides for the control of different pest [18], [19]. Neem, West African black pepper, garlic bulb and African nutmeg, Lippia adoensis Hockst have been reported to be effective against some crop pests species [20]. Therefore, the results presented in this study showed that application of Garlic and Chilli combination solution on cabbage crop after five days sprayed significantly increased the efficiency on control BDM and other insect pests when compared with control treatment (Table III). It seems that garlic and chilli acts as a repellent for insects. Because, Garlic and chilli produces a pungent alliaceous compound, which probably is responsible for its pest repellent attribute. This results are in agreement with [22] who stated that ginger, chilli

pepper and garlic bulb are good biocontrol agents of some insect pests of cowpea. On the other hand, efficacy of soap 0.1% on control insect pest in cabbage crop was also significantly higher compared to untreated control.

TABLE III
EFFICIENCY OF GARLIC AND CHILI COMBINATION SOLUTION ON CONTROL
BDM AND OTHER INSECT PEST CABBAGE VEGETABLE¹

Treatment	After sprayed 5 days		
	Diamondback moth (%)	Cutworm (%)	Flea Beetle (%)
Control	0.0c	0.0c	0.0c
Soap 0.1%	8.26b	7.88b	3.76b
Garlic and chili combination + soap 0.1%	62.03a	56.55a	88.16a

1. Mean in each column followed by the same letters are not significantly different at $P \leq 0.05$ according to Duncan's multiple range test.

IV. CONCLUSION

It can be concluded that the application of Garlic and chili combination + soap 0.1% greatly reduced the number of days required for the head formation and maturity in cabbage. This results of the study also indicated that the weight of cabbage head was greatly improved by application of Garlic and chili combination + soap 0.1%. Moreover, sprayed of Garlic and chili combination + soap 0.1% greatly resistance the effect of cabbage insect pests, and also clearly enhanced the quality in cabbage production. Therefore, we can be concluded that application of Garlic and chili combination + soap 0.1% would have substantial positive impacts, promoting agricultural productivity and human nutrition without the deleterious environmental and health to meet commercial demands.

ACKNOWLEDGMENT

The authors thank to our friends for technical help in the fieldwork.

REFERENCES

- [1] A.M. Shelton, J. A. Wyman, N.L. Cushing, K. Apfelbeck, T.J. Dennehy, S.E.R. Mohr, and S.D. Eigenbrode, "Insecticide resistance of diamondback moth, *Plutella xylostella* (Lepidoptera: Plutellidae) in North America," *Journal of Economic Entomology*, 86, pp: 11-19. 1993
- [2] B.E. Tabashnik, N.L. Cushing, and M.W. Johnson, "Diamondback moth (Lepidoptera: Plutellidae) resistance to insecticides in Hawaii USA: intra-island variation and cross-resistance," *Journal of Economic Entomology*, 80, pp: 1091-1099. 1987
- [3] C. F. Henderson, and E. W. Tilton, "Tests with acaricides against the brow wheat mite" *J. Econ. Entomol*, 48, pp. 157 – 161. 1955
- [4] D. Miller, "Food Chemistry: A Laboratory Manual," 1st ed. John Wiley and Sons, New York, USA. 1998
- [5] FAO, "Traditional Food Plant," Food and Agricultural Organization of the United Nations, Rome, Italy. 1988
- [6] M.Jim, and N. Tony, "Cabbage growing Primefact 90," (replaces GFACT. H8. 1.27. NSW Department of primary Industries (publ), pp 1 - 7. 2006.
- [7] M. Smith, "Report on the expert consultation on procedures for revision of FAO guidelines for predictions of crop water requirement. Rome FAO, 45p. Soil types effects on Growth and dry matter production of spring onion," *Journal of Horticultural Sciences and Technology*, 77, pp 340 - 5. 1995
- [8] N.S. Talekar, and A.M. Shelton, "Biology, ecology and management of the diamondback moth," *Annual Review of Entomology*, 38, pp: 275-301. 1993.
- [9] R.P. Dhengle, and A.M. Bhosale, "Effect of plant growth regulators on yield of cabbage (*Brassica oleracea* var. capitata)," *International Journal of Plant Sciences*, 3(2), pp 376-378. 2008
- [10] S. S. Liu, E. J. Brough, and G. A. Norton, "ACIAR Workshop Report: Integrated Pest Management in Brassica Vegetable Crops", Cooperative Research Centre for Tropical Pest management, Brisbane, Australia. 1996
- [11] Z. H. Shi, and S. S. Liu, "Toxicity of insecticides commonly used in vegetable fields to the diamondback moth, *Plutella xylostella*, and its parasite, *Cotesia plutellae*," *Chinese Journal of Biological Control*, 14, pp 53-57. 1998 (in Chinese with English summary).
- [12] Z. H. Shi, S. J. Guo, W. C. Lin, and S. S. Liu, "Evaluation of selective toxicity of five pesticides against *Plutella xylostella* (Lep: Plutellidae) and their side effects against *Cotesia plutellae* (Hym: Braconidae)," *Pest Management Science* 60, pp 1213-1219. 2004
- [13] V.P. Sawant, D.M. Naik, S.R. Barkule, A.M. Bhosale, and S.B. Shinde, "Effect of foliar application of growth regulators on growth, yield and quality of cabbage cv. GOLDENACRE," *The Asian Journal of Horticulture*, 5(2), pp: 495-497. 2010
- [14] M. Waiganjo, C. Waturu, J. Mureithi, J. Muriuki, and J. Kamau, "Use of entomopathogenic fungi and neem bio-pesticides for Brassica pests control and conservation of their natural enemies," *East Afr Agric Forestry J* 77, pp: 545-549. 2011
- [15] K. Weinberger, and R. Srinivasan, "Farmers' management of cabbage and cauliflower pests in India and their approaches to crop protection," *J Asia Pac Entomol* 12, pp: 253-259. 2009
- [16] M.P. Zalucki, A. Shabbir, R. Silva, D. Adamson, and L. Shu-Sheng, "Estimating the economic cost of one of the world's major insect pests, *Plutella xylostella* (Lepidoptera: Plutellidae): Just how long is a piece of string," *J Econ Entomol* 105, pp: 1115-1129. 2012
- [17] P. Devanand, and P.U. Rani, "Biological potency of certain plant extracts in management of two lepidopteran pests of *Ricinus communis* L.," *J of Biopesticides* 1, pp: 170-176. 2008
- [18] A.M. Oparacke, M.C. Dike, and C.I. Amatobi, "Insecticidal potential of extracts of garlic, *Allium sativum* L. bulb and African nutmeg, *Monodora myristica* (Gaertn) dunal seed for insect pests control on cowpea," *ESN Occasional Publication*. 32, pp: 169-174. 2000b
- [19] S.H.O. Okech, C.K.M. Kaposhi, K. Chisembun, and M.P. Mundia, "Potential of *Tephrosia vogelii* water extract for controlling the maize stalk borer, *Chilo partellus*," *African Journal of Plant Science*, 7, pp: 17-25. 1997.
- [20] L.E.N. Jackai, and I.O. Oyediran, "The potential of neem *Azadirachta indica* A. Juss. for controlling post flowering pests of cowpea *Vigna unguiculata* (L.) Walp. The pod borer, *Maruca vitrata*," *Insect Science and its Application*, 9, pp: 267-276. 1991.
- [21] S. Gaby, "Natural Crop Protection in the Tropics," 2nd Enlarged and Revised edition. Margraf Verlag Press 502 PP. 2000
- [22] S.B. Panhwar, "Farmers adoption of plant materials for insects control," *International Service for National Agricultural Research*. Haque, Netherland. 4, pp: 61-68. 2002.