BIO-INTENSIVE MANAGEMENT OF INSECT PESTS ON BLACK GRAM

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Abstract : This study was carried out to determine the insecticidal effect of three plant leaf extract as a part of utilization of bio-resources as bio-pesticide to minimize the chemical insecticidal hazard against four selected insect pests on black gram. The experiment was done in a random block design in a black gram field without any interference. The aqueous leaf extract of *Ipomea fistulosa* , *Annona reticulata* and *Polygonum hydropiper* were prepared according to traditional knowledge and tested for its pesticidal (anti-feedant) activity against the insect pests such as Aphids (*Aphis craccivora*), *Apion clavipes*, *Maruca testulalis* and leaf weber (*Omiodes indicata*) in a field . From the experiment it is found that both anti-feedant activity and lethal effect of the extracts on the insects were significant and the results indicated that *Ipomea fistulosa* and *Annona reticulata* was more effective. This study may lead to further investigation and in the development of eco-friendly pest management techniques.

IndexTerms -- *Annona reticulata*, bio-intensive pest management, bio-resource, black gram, insect pests, *Ipomea fistulosa*, leaf extract, *Polygonum hydropiper*.

I. INTRODUCTION

In Assamese society black gram (*Vigna mungo* L.(Hepper)) is popularly known as "mati mah" and considered as a special commodity for different purposes. It is used in a very special cuisine as "black gram with soda''. In terms of production and importance it is the fourth most important short duration pulse crop grown in India which belongs to the family *leguminosae* and sub family *papilionaceae*. Both the seed and the plant have different utility such as protein food value, medicinal value, nitrogen fixing ecological value all are enhances to the importance of black gram. The second most populous country India produces a large amount of black gram, but it is not sufficient in terms of the growing population. Moreover the production of black gram is interrupted by different insect pests in the field at all stages of growth. In India, quantitative avoidable losses (7.35%) caused by insect pest complex, both in black gram and green gram vary with different agro-climatic conditions (Hamad S.E., Dubey S.L., 1983). A survey was carried out by this author during kharif season from August, 2016 to November, 2016 to know the incidence of various insect pests which damage the crop. 15 species of insect pests have been recorded in all stages of the black gram in the field. Among them, aphid (*Aphis craccivora)*, leaf hopper (*Empoasca kerri)*, grass hoppers (*Attractomorpha crenulata)* , bihar hairy caterpillar(*Spilosoma obliqua)*, coreid bugs (*Riptortus linearis* and *Clavigralla gibbosa)*, pentatomid bug (*Nezara viridula)*, pod boring weevil (*Apion clavipes)*, white fly (*Bemicia tabaci)*, leaf weber (*Omiodes indicata)*, grey weevil (*Mylloceros undecimpustulatus)*, blue butterfly (*Lampides boeticus)*, pulse beetle (*Callosobruchus maculatus)* were considered as serious defoliators and sucking pests. These insects can cause severe problems in the production through direct damage to the crops.

To protect the crop against these insect pests heavy usage of pesticides often leads to hazards to plants and animals including man. Due to this type of challenges, an alternative to the use of synthetic pesticide are the need of the day to maintain ecological balance (Yanggen *et al*., 2004). Though chemical control of insect pests is preferred by the farming community but the use of chemicals is not advisable due to its hazard in different forms and in different animals and plants. Therefore, the people of the globe are now busy to search out some non-chemical strategies to manage the pests which are eco-friendly, more economical and safe to consumers. The latest trend of pest management revolves in and around the use of plant extracts. These are available locally and farmers can prepare themselves easily.

Again complete dependence on chemical control has led to unsatisfactory pest management, followed by diminishing profits. At present in many countries bio-intensive pest management technologies are adopted to alleviate the pest problems in some major crops. (Ajayi and Lale, 1996). Through this improved pest management farmers have increased yields and decreased expenditure on pesticides. Bio-intensive management of pest is a part of Integrated Pest Management (IPM). It incorporates ecological and economic factors into agricultural system design and decision making and addresses public concerns about environmental quality and food safety. The benefits of bio-intensive IPM include reduced chemical input costs, reduced on farm and off farm environmental impacts and more effective and sustainable pest management. Such reductions will benefit the grower and society. The fastest growing human civilization in terms of development at the cost of their environment though a matter of frustration but still a class of people like tribal and some rural folks are maintaining a close sustainable link with the ecosystem. They are living with the nature causing hardly any constraints to its virginity. They derive their essentials from the diversity of bio-resources. Thus, they develop the knowledge system of utilization of the plant resources to manage the insect pests of their essential commodities and crops. The plant derivatives are currently being evaluated to meet a new world order of producing crops without the use of agro-chemicals (Jewel, 2008). Botanicals have the advantage of not only being available and affordable but it is also biodegradable and eco-friendly Plants produce a range of chemical compounds to protect themselves from various insect pests. These include alkaloids, terpenoids,flavonoids and acetogenins, such as azadirachtin, isolated from the foliages of Neem. Secondary metabolites from plants such as *Pyrethrum*, *Sabadilla* and *Carvone* were shown to have biological activity, protecting the plant from pathogens and at the same time non-toxic to mammals, fish and pollinators (Dubey et al., 2010). Compounds derived from such plants in general, possess no mammalian toxicity and hence may be exploited for controlling pathogens and insect pests of agriculturally important crops. It was revealed that majority of farmers were aware about plant bio resource

utilization in crop protection and these are known to them from senior farmers. Among them marginal farmers depend on more plant resource than medium and large farm holding farmers for insect pest management in the field. This may be due to the high cost of chemical insecticide and pesticide against low cost of utilization of surrounding plant resource for crop protection. Prakash and Rao(1986,1989,2003); Prakash et al.,(1987,1989,1990) showed that botanical pesticides are the important alternatives to minimize or replace the use of synthetic pesticides as they possess an array of properties including toxicity to the pest, repellency, anti-feedance, insect growth regulatory activities against pest of agricultural importance. Sagheer et al. (2013) and Khan et al. (2013), studied the use of plant extracts in different formulations as repellants which is safe for human health, eco-friendly and less expensive to control the insect pests. D.B. Kara, D.M. Korat and M.R. Dabhi (2014) conducted a field experiment on evaluation of botanicals i.e. neem seed kernel extract @ 5%, neem oil @ 0.3%; leaf extracts of neem, Jatropha, Naffatia (*Ipomea fistulosa*), custard apple (*A. reticulata*) and arduso against insect pests infesting brinjal at Anand Agricultural University, Gujarat and found neem seed kernel as most effective. Rajashree pandey in 2015 studied the treatment of leaf extract of *L. camara* and *I. fistulosa* on the mortality of *H. armigera* larvae.

To enhance eco-friendly agriculture, the role of existing botanicals as well as different new plants are very much necessary to know which may serve the purpose of botanical pesticides in any cultivation. Information on efficacy of botanicals against insect pests of black gram is very low and therefore the present study was carried out to know the efficacy of the leaf extract of three plants namely *Annona reticulata* , *Ipomea fistulosa* and *Polygonum hydropiper* against some selected insect pests of black gram.

II. RESEARCH METHODOLOGY

The experiment was carried out in a field located in the Village-Dehar Kuriha in the District Kamrup (Rural), State- Assam during September, 2016 to November, 2016. Coordinates of the field area are Latitude-26.3303^{0}N, Longitude- 91.5148^{0}E.
Like the rest part of the state Assam, this area also has tropical monsoon type of climate having high humidity. Temperature increases in summer season. Summer starts from March, extends to start of May. Monsoon remains from May to August, autumn from September to October and winter from November to February. During the study period temperature was ranging from 33^{0}C to 17^{0}C and relative humidity from 96% to 80%. Soil type of this area are alluvial consists of sand, silt, clay and humus.
Extensive cultivation of black gram is done throughout the bank of the river Brahmaputra from Rural Kamrup to Nalbari district. Mainly the local variety called “Saonia mah” is preferred by the farmers. It is seen that some people cultivate black gram in paddy nursery field just before few days of transplantation of the rice plant. When the rice plant is ready to transplant, it is taken away and only the black gram plant remains and thereby a mixed cropping is done which help to fertilize the nursery field naturally by the roots of the black gram. Such type of plot was taken for our experiment where no artificial fertilizer, pesticide or irrigation was practiced for the crop growth.
The experiment was laid out in a randomized block design and replicated 3 times including untreated and treated without human manipulation of spacing between row to row and plant to plant. For bio-intensive pest management 3 plants were selected namely *Annona reticulata* (custard apple, sitaphal), *Ipomea fistulosa* (naffatia, amarlota) and *Polygonum hydropiper* (bihlongoni). *A. reticulata*, Family-Annonaceae is a semideciduous tree grown up to 10 meters tall. *P. hydropiper* commonly known as “patharua bihlongoni”, is a plant of the family-Polygonaceae. *I. fistulosa* commonly known as “morning glory” or “besharm” belongs to convulvulaceae family. All the plant species were identified with the help of relevant and standard literatures.

Fresh leaves, 1 kg from each of the three plants were plucked and surface dried in sun shade. Then the dried leaves were ground by electric grinder. The powder so obtained were soaked in 5 litre of water and allowed to decompose for 72 hours at room temperature. Then it was filtered through muslin cloth to get aqueous filtrate (Centre for Indian Knowledge system, 2011). The plots in each treatment were sprayed with the extracts by a sprayer, ensuring uniform coverage of the area. Data were taken for 4 important insect pests – Aphids (*Aphis craccivora*),*Apion clavipes*, *Maruca testulalis* and leaf weber(*Omiodes indicata*), before 24 hours of spray and after 24 hours and after 48 hours.. The field spray was done in 38th standard week of the year 2016, after 35 days from sowing of the seeds. For direct mortality test the *Apion clavipes* and larva of leaf weber were collected from the crop field and they were exposed to the extract in laboratory in transparent containers. All the data obtained were analyzed statistically to validate the result of the experiments.

III. RESULTS AND DISCUSSION

During 38th standard week of 2016, the experiments were carried out to find the results on efficacy of the three plant extracts on the four insects. are presented in table-1, 2,3 and 4. The data of pre-treatment count on insect population which were recorded 24 hours prior to the spray are also presented in the tables which showed more or less uniform distribution of the pest in the crop. Direct mortality test of two pests due to the plant extracts were also carried out.The result on the direct mortality test of Apion and Leaf weber are presented in table-5.

Table 1: Efficacy of plant extracts on Aphid population

Treatments	Extract	Mean population of Aphid/5 plants					
		Before 24 hrs. of spray	After 24 hrs. of spray	Reduction in %	After 48 hrs. of spray	Reduction in %	Mean reduction in %
T_1	*Annona reticulata*	26.66(5.16)	7.33(2.80)	70.28	0.33(0.91)	98.43	84.36
T_2	*Ipomea fistulosa*	22.66(4.76)	5.33(2.41)	78.39	0.66(1.08)	96.86	87.63
T_3	*Polygonum hydropiper*	21.33(4.67)	8.33(2.97)	66.22	6.33(2.61)	69.86	68.04
T_4	Controlled	25.33(5.50)	24.66(5.44)	00	21.00(4.64)	00	00
	General Mean	23.99	11.41	53.72	7.08	66.29	60.01
	SD±	2.43	8.91	36.17	9.68	46.10	40.91
	SEm±	1.22	4.46	18.09	4.84	23.05	20.46
	CV%	10.14	78.15	67.33	136.72	69.54	68.18

F value=5.17>F_c =4.256 significant
LSD=11.04

Table 2: Efficacy of plant extracts on the population of *Apion clavipes*

Treatments	Extract	Mean population of *Apion clavipes*/5 plants					
		Before 24 hrs. of spray	After 24 hrs. of spray	Reduction in %	After 48 hrs. of spray	Reduction in %	Mean reduction in %
T_1	*Annona reticulata*	10.33(3.29)	3.33(1.96)	64.31	2.66(1.78)	72.46	68.39
T_2	*Ipomea fistulosa*	11.66(3.49)	3.66(2.04)	60.77	2.33(1.59)	75.88	68.33
T_3	*Polygonum hydropiper*	9.33(3.14)	4.33(2.20)	53.59	3.33(1.96)	65.53	59.56
T_4	Controlled	9.66(3.19)	9.33(3.14)	00	9.66(3.19)	00	00
	General Mean	10.25	5.16	44.67	4.50	53.47	49.07
	SD±	1.03	2.81	30.11	3.47	35.90	32.98
	SEm±	0.52	1.40	15.06	1.73	17.95	16.49
	CV%	10.06	54.42	67.41	71.16	67.15	67.20

F value=5.656>F_c=4.256 significant
LSD=3.63

Table 3: Efficacy of plant extracts on the population of leaf weber

Treatments	Extract	Mean population of Leaf weber/5 plants					
		Before 24 hrs. of spray	After 24 hrs. of spray	Reduction in %	After 48 hrs. of spray	Reduction in %	Mean reduction in %
T_1	*Annona reticulata*	6.33(2.61)	0.66(1.08)	89.00	0.33(0.91)	94.79	91.90
T_2	*Ipomea fistulosa*	7.33(2.80)	1.33(1.35)	77.83	0.66(1.08)	89.57	83.70
T_3	*Polygonum hydropiper*	5.66(2.48)	1.66(1.47)	72.33	1.33(1.35)	78.99	75.66
T_4	Controlled	5.66(2.48)	6.00(2.45)	00	6.33(2.61)	00	00
	General Mean	6.25	2.41	59.79	2.16	65.84	62.82
	SD±	0.79	2.43	40.46	2.81	44.38	42.40
	SEm±	0.39	1.21	20.23	1.40	22.19	21.20
	CV%	12.64	100.63	67.67	129.91	67.41	67.50

F test=4.361>F_c=4.256 significant
LSD=3.3

Table 4: Efficacy of plant extract on the population of *Maruca testulalis*

Treatments	Extract	Mean population of *Maruca testulalis*/5 plants					
		Before 24 hrs. of spray	After 24 hrs. of spray	Reduction in %	After 48 hrs. of spray	Reduction in %	Mean reduction in %
T_1	*Annona reticulata*	3.33(1.96)	1.33(1.35)	55.67	0.66(1.08)	80.18	67.93
T_2	*Ipomea fistulosa*	2.66(1.78)	0.66(1.08)	78.00	0.33(0.91)	90.09	84.05
T_3	*Polygonum hydropiper*	3.66(2.04)	1.33(1.35)	55.67	1.33(1.35)	60.06	57.87
T_4	Controlled	3.00(1.87)	3.00(1.87)	00	3.33(1.96)	00	00
	General Mean	3.16	1.58	47.34	1.41	57.58	52.46
	SD±	0.42	1.00	32.27	1.34	40.37	36.60
	SEm±	0.22	0.50	16.63	0.67	20.19	18.30
	CV%	13.59	63.16	70.28	82.4	70.11	69.76

F value=3.745<F_c=4.256 not significant
LSD=1.5

Table 5: Direct mortality test of plant extract on leaf weber and *Apion* spp.

Treatment	Leaf weber		Apion	
	% Mortality after 24 hrs.	% Mortality after 48 hrs.	% Mortality after 24 hrs.	% Mortality after 48 hrs.
Annona reticulata	100	100	70	100
Ipomea fistulosa	100	100	90	100
Polygonum hydropiper	60	90	40	60
Controlled	20	40	10	20
SEm±	19.15	14.36	17.5	19.15
CV%	54.71	34.82	66.67	54.71

Efficacy on Aphids :

The incidence of aphid on black gram under the four treatments has been shown in Table 1.The data in each of the treatment shows that before 24 hours of spray the general mean population of Aphids were 25.33 with a standard deviation of 2.43, standard error of mean 1.22 and coefficient of variation in percentage was 10.14.

After the first spray of the three plant extracts, the data taken from the field revealed that the lowest number of reduction 66.22% in *P. hydropiper* , 70.28% in *A. reticulata* and highest number of reduction 78.39% in *I. fistulosa* treatment was observed after 24 hours of treatment.

From the black gram field again population data were taken after 48 hours of treatment and the percentage reduction was observed as highest 98.43% in *A. reticulata*, 96.86% in *I. fistulosa* and followed by lowest 69.86% in *P. hydropiper* extract. The mean percentage reduction of Aphid was found as 84.36 in *A. reticulata*, 87.63% in *I. fistulosa* and 68.04% in *P. hydropiper*. So the best control is seen in the extract of *I. fistulosa* with the pest reduction percentage of 87.63%.If the reduction rate is 60% or above, the extracts can be considered as good for the management of Aphid. The result were analyzed by applying ANOVA and found that the F-value is significant to reject the null hypothesis which means that the means of the population of Aphid after treatment is significantly different from each other. The least significant difference (LSD) value was also calculated and found as 11.04. This value states that the reduced population means are significantly different. The value of Coefficient of Variation(CV) in percentage were found as 78.15% at 24 hours , 136.72% at 48 hours and 68.18% at mean reduction of the population of Aphids. The high value of CV means the population data are not very close to the mean but spread out from one another.

In the experiment, the result of *A. reticulata* supported the findings of Rosaiah (2001) who reported that the leaf extract of *A. reticulata* showed high effectiveness against the aphid of bhendi. Again, ether extract of *A. reticulata* leaf was tried against cotton aphid, *A. gossypii* at Tirupathi. These leaf extracts gave 88.81 to 90.06 per cent reduction in aphid population (Chitra *et al.*, 1997).

Efficacy on *Apion* :

The incidence of Apion on black gram under the four treatments has been shown in Table 2.The data in each of the treatment shows that before 24 hours of spray the general mean population of *Apion* spp.were 10.25 with a standard deviation of 1.03, standard error of mean 0.52 and coefficient of variation in percentage was 10.06

After the first spray of the three plant extracts, the data taken from the field reveal that the lowest number of reduction 53.59 in *P. hydropiper*, 64.31 in *A. reticulata* which is the highest number of reduction and 60.77 in *I. fistulosa* treatment was observed after 24 hours of treatment.

From the black gram field again population data were taken after 48 hours of treatment and the percentage reduction was observed as 75.88% in *I. fistulosa*, 72.46% in *A. reticulata* and followed by 65.33% in *P. hydropiper* extract. The mean percentage reduction of *Apion* was found as 68.39 in *A. reticulata*, 68.33% in *I. fistulosa* and 59.56% in *P. hydropiper*. So the best control is seen in the extract of *A. reticulata* with the pest reduction percentage of 68.39%.If the reduction rate is 60% or above, the extracts can be considered as good for the management of *Apion*. The result were analyzed by applying ANOVA and found that the F-value is significant to reject the null hypothesis which means that the means of the population of Aphid after treatment is significantly different from each other. The least significant difference (LSD) value was also calculated and found as 3.63. This value states that the reduced population means are significantly different. The value of Coefficient of Variation(CV) in percentage

were found as 67.41% at 24 hours , 67.15% at 48 hours and 67.20% at mean reduction of the population of *Apion*. The high value of CV means the population data are not very close to the mean but spread out from one another.

Efficacy on leaf weber:

The data on the efficacy of plant extracts against leaf weber is presented in Table 3. It is noticeable from the result that the population of leaf weber before the first spray of plant extract, varied around a mean value of 6.25 per five plants with a standard deviation(SD) of ±0.79, standard error of the mean(SEm) of ±0.39 and coefficient of variation(CV%) as 12.64. However, after the treatment, significant reduction in the leaf weber population was observed in all the treatments after 24 hours and 48 hours of the treatment .

It is visual from the data after 24 hours that the population of the leaf weber brought down to 0.66-1.66 per five plants in the treated plots as against control (6.00 per five plants). The difference was significant. The reduction population of leaf webers in different treatments varied from 72.83% -89.00%. The maximum reduction was recorded at *A. reticulata* (T1) (89.00%) closely followed by *I. fistulosa* (T2) 77.83% and *P. hydropiper* (T_3) 72.33% reduction in Leaf weber population.

The data after 48 hours of treatments were also showed significant reduction in the pest population and brought down the number to 0.33-1.33 per five plants in each plot against control (6.33 per five plants). The percentage reduction in the population of Leaf weber was varied from 94.79% - 79.99%. The maximum reduction was recorded at *A. reticulata* (T_1) (94.79%), followed by *I. fistulosa* (T_2) 89.57% and *P. hydropiper* (T_3) 79.99% reduction in Leaf weber population. The result were analyzed by applying ANOVA and found that the F-value is significant to reject the null hypothesis which means that the means of the population of Leaf weber after treatment is significantly different from each other. The least significant difference (LSD) value was also calculated and found as 3.3. This value states that the reduced population means are significantly different. The value of coefficient of variation(CV%) in percentage were found as 67.67% at 24 hours , 67.41% at 48 hours and 67.50% at mean reduction of the population of Leaf weber. The high value of CV means the population data are not very close to the mean but spread out from one another.

Efficacy on *Maruca testulalis:*

The data on the efficacy of plant extracts against *M.testulalis* is presented in Table 4. It is noticeable from the result that the population of *M.testulalis* before the first spray of plant extract, varied around a mean value of 3.16 per five plants with a standard deviation(SD) of ±0.42, standard error of the mean(SEm) of ±0.22 and coefficient of variation(CV%) as 13.59. However, after the treatment, significant reduction in the *M.testulalis* population was observed in all the plots after 24 hours and 48 hours of the treatment **.**

It is visual from the data after 24 hours that the population of the *M.testulalis* brought down to 0.66-1.33 per five plants in the treated plots as against control (3.00 per five plants). The difference was significant. The reduced population of *M.testulalis* in different treatments varied from 55.67% -78.00%. The maximum reduction was recorded at *I. fistulosa* (T_2) (78.00%), closely followed by *A. reticulata* (T_1) 55.67% and *P. hydropiper* (T_3) 55.67% in the pest population.

The data after 48 hours of treatments were also showed significant reduction in the pest population and brought down the number to 0.33-1.33 per five plants in each plot against control (3.33 per five plants). The percentage of reduction in the population of *M.testulalis* was varied from 90.09% - 60.06%. The maximum reduction was recorded at *I. fistulosa* (T_2) (90.09%), followed by *A. reticulata* (T_1) 80.18% and *P. hydropiper* (T_3) 60.06% in *M.testulalis* population. The result were analyzed by applying ANOVA and found that the F-value is not significant to reject the null hypothesis which means that the means of the population of *M.testulalis* after treatment by different extract is not significantly different from each other. The least significant difference (LSD) value was also calculated and found as 1.5. This value states that the reduced population means are significantly different. The value of coefficient of variation(CV%) in percentage were found as 70.28% at 24 hours , 70.11% at 48 hours and 69.76% at mean reduction of the population of *M.testulalis* . The high value of CV means the population data are not very close to the mean but spread out from one another.

Direct mortality test:

The two insects after exposure to the extracts were kept in transparent apparatus and observation was done first at 24 hours interval and second at 48 hours interval. The data recorded from observation after 24 hours shows that mortality of Leaf weber due to *A. reticulata* is 100%, *I. fistulosa* was 100% and *P. hydropiper* was 60% .After 48 hours the effect of *P. hydropiper* became 90% only. Therefore, from the record it is observed that *A. reticulata* and *I. fistulosa*

leaf extract have a good mortality in comparison to *P. hydropiper*. The mortality of *Apion* was recorded after 24 hours as 70% at *A. reticulata*, 90% at *I. fistulosa* and 40% at *P. hydropiper*. After 48 hours the effect of *A. reticulata* and *I. fistulosa* became 100% but in *P. hydropiper* it became only 60%. The extract of *A. reticulata* and *I. fistulosa* has good mortality effect on *Apion* than *P. hydropiper*.

The results of this study have shown that aqueous leaf extract of *A. reticulata, I. fistulosa* and *P. hydropiper* contained substances that can confer some level of protection against field insects when compared with the unprotected control. The aqueous leaf extract performed good in reducing the number of pest incidence. This may be attributed to the fact that their leaves has been reported to possess insecticidal and repellent properties (Jewel, 2008). The phytochemical screening of *A. reticulata* leaves revealed the presence of alkaloids, tannins, steroids, terpenoids and coumarin (Rani, D.J. et al., 2013). Phytochemicals are secondary metabolic compounds found in plants. Many of these are known to provide protection against insect attacks and plant diseases (James, W. et. al., 1983 & Nithya, T. G. et. al., 2011). The toxic effects of *I. fistulosa* were also well known from the study of Mishra et al., (1979) and Khara et al., (1982). Ayaz, M. et al.(2016) studied the chemical profiling, antimicrobial and insecticidal evaluation of *Polygonum hydropiper* L. and supported previously reported insecticidal property of saponins and may provide scientific justification for the ethno-medicinal uses of the plant. The use of botanicals in crop protection has now gained a popular ground in the world of agriculture as an alternative to toxic, persistent and synthetic compounds. At present, serious attention is drawn to extracts from plants that contain substances in the form of alkaloids or inhibitors, which help in managing

the agriculturally important pests. A number of references are available in support of this hypothesis. Botanicals isolated from plants serve as an alternative to chemical pesticides and fertilizers (Murrey et al., 2000;Lacey and Shapiro-Ilanan, 2008).

IV. CONCLUSION:

The rising concern and eco-friendly approaches on health and the environment would require detailed analyses of the impacts of various bio-pesticides. Realizing the bottlenecks in bio-pesticide availability at farm level, effective production technologies should be developed at different level. This will not only addresses the availability, economics and time, but also may generate employment opportunities for rural people. Though bio-intensive pest management proved effective in the management of insect pests, rate of adoption is generally low. It may be associated with lack of understanding, availability of options, dependence on chemical pesticides as a habit, inability to distinguish between pests and beneficial insects, and lack of appreciation of the biological approach to crop protection. However, further research should be carried out and sophisticated method of extracting the active ingredient of these botanicals should be used to enhance the total release of some of the active compounds contained in them that were not adequately released into the aqueous solvent that was used for extracting the plant products.

In this investigation, when the leaf extract of the three plants were evaluated for their efficacy against four selected insect pests, considerable mortality was found over treatment of *A. reticulata*, *I. fistulosa* and *P. hydropiper*. Hence, it is concluded that there were some secondary metabolites present in *Annona*, *Ipomea* and *Polygonum* were capable of inhibiting the insect pests.

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