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Knowledge and Practices on Eggplant Fruit and Shoot Borer, *Leucinodes orbonalis* Guenee Management in Dhading and Bara Districts of Nepal

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Abstract:

A field survey was conducted to study knowledge and practices of eggplant growers on eggplant fruit and shoot borer, *Leucinodes orbonalis* Guenee management in Dhading and Bara districts of Nepal in 2012. Information was collected from 80 eggplant growers, 40 from each district using semi-structured questionnaires. Field survey revealed that eggplant occupied an imperative place in commercial vegetable production. All eggplant growers relied on indiscriminate use of chemical pesticides of different groups. However, 35 percent growers adopted some indigenous knowledge regarding use of non-chemical practices, like urine fermented botanicals; cow urine; ash; chinaberry fruit extract; tobacco leaf extract; mixture of shampoo, lemon juice, kerosene and sakhkhar; Tagetes border cropping and coriander intercropping. The little knowledge and practices on safety precautions for pesticide use has created negative impacts on farmers health. Hence, the indigenous knowledge and practices needs validation and promotion along with farmer awareness for public health.

Keywords: Indigenous knowledge, eggplant fruit and shoot borer, safety precautions, pest management.

1. Introduction

Eggplant, *Solanum melongena* Linnaeus is ecnomically important vegetable of south asia including Nepal [35]. It possesses particular significance among vegetable because of its availability throughout the year [25] and high yield associated with longer harvesting period [11]. However, the key pest, *Leucinodes orbonalis* Guenee menacing its cultivation [19].

L. orbonalis is one of the most economic pest of Nepal, India, Pakistan, Srilanka, Bangladesh, Thailand, Pilippines, Cambodia, Laos and Vietnam [4] and causing huge loss in almost eggplant growing areas [7]. It reduces the quality of fruit production and attacks eggplant irrespective to growth stages of plant unlike other pests [24]. Larvae bore inside the fruit and reduce its yield upto 75 percent [15].The pest infestation mostly concided with the onset of flowering stage and appeared peak during fruiting[2].

Some local or traditional practices [32, 18, 10] or combination with chemicals [27]are practiced by some Nepalese farmers, but these are not popular [14]. The use of synthetic insecticides for the control of *L. orbonalis* has been the standard practice [21]. Nearly all farmers rely exclusively on chemical insecticides to produce blemish-free marketable fruits [6] and they used pesticides indiscriminately right form the day of seed sowing to final harvest [34]. Farmers use pesticides from all major classes with higher dose and frequency without consideration of proper pre-cautionary practices [6]. Tremendous misuse of chemicals pesticides have been reported form different countries e.g. more than 140 times in Bangladesh [1], 56 times in Philippines [8, 20], 25 to 30 times in Nepal [11]. The situation has led to resistance development in pest, resurgence of secondary pests, high pesticide residues in produce and decimation of natural enemies [33]. It reduces profitability of eggplant production, makes eggplant more expensive to consumers, poses health hazards and causes environmental pollution and resource degradation [1].

Any single method of pest management cannot attain a significant level of *L. orbonalis* management. For this, integrated pest management (IPM) strategies have been recommended to alleviate such a problem [33] however; impact was not satisfactory [22]. Still

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there is absence of economical, eco-friendly and socially accepted IPM solutions. In this regards, for the development of suitable IPM package, farmer's knowledge and practices should be recognized. Therefore, this study was conducted to identify the farmers' indigenous/existing knowledge and practices of *L. orbonalis* management in Dhading and Bara districts of Nepal.

2. Material and Methods

The field survey was carried out in vegetable pockets with considerable acres under eggplant in Bara and Dhading districts. From each district 2 VDCs were selected based on secondary data from respective District Agriculture Development Offices and local research stations. Among the eggplant growers 20 growers from each VDC were randomly selected. The selected VDC were Dhusa and Benighat from Dhading and Buniyad and Banjariya from Bara.

The field survey was conducted using semi-structured questionnaires. Preliminary field visit was conducted to obtain the general information as well as background of the study area. Prior to actual survey, pre-testing of the questionnaire was done in Bhaktapur districts and necessary modifications were made. The survey was carried out during June-July 2012 in Dhading and August-September in Bara. In addition, informal discussion and field visits were done to triangulate the information obtained.

Finally, the collected data were coded, entered, managed and analyzed by using Micro-Soft EXCEL and Statistical Packages for Social Science version 17. The chi square test at $p<0.05$ was performed to compare the attributes of qualitative/categorical Variables.

3. Results and Discussion

3.1. Demography and social characterization of eggplant growers

Majority of the eggplant growers (68%) were male and of the middle-age class (66%). About 25 percent were illiterate, 16 percent have 5 years of formal education, 2 percent up to 10 years of formal education, 23 percent intermediate and 11 percent graduate and post graduates. Half of eggplant growers (50%) were involved in vegetable farming for more than 20 years. Thirty percent of the respondents were found using pesticides for more than 20 years (Table 1).

Vegetable farming in surveyed area covered 46 percent of total farm land, among which eggplant covered 21 percent area. The eggplant was found to be cultivated as summer rainy season crop by 91 percent eggplant growers in Dhading, while it was cultivated as autumn winter season by 86 percent in Bara district.

3.2 Awareness on pesticide use

About fifty percent of the growers read pesticide labels, most frequently red and green colour classes. Only 16 percent were able to correctly understand the meaning of all color classes. It might be due to low level of knowledge and carelessness of the users. Author [12] have also reported similar trends of awareness about pesticide labels in Bara and Dhading districts. In regards of not reading the level of pesticides, most of the respondents in the current study (28.75%) were found to believe on pesticide dealer/retailer, 25 percent do not think it is necessary and 7.5 percent do not have such type of knowledge. The sources of pesticide recommendation for 54 percent of the respondents were pesticide dealers/retailers, while 30 percent decides by their self experiences and 21 percent get suggestion from their neighbors. Ten percent of the farmers get pesticide recommendations from Agricultural Technicians.

About 55 percent of eggplant growers followed safety measures partially before during and after application of pesticides . Authors [16, 28] have also similar reports. Other outhors [17, 5, 12] reported that even those farmers who are aware that the use of pesticides is precarious also are not conscious about all the risk and they do not adopt adequate safety measures while applying pesticides.

Only 21.25 percent of eggplant growers considered adequate waiting period. Author [32] reported that in many places farmers applied pesticides in a routine manner without considering the waiting period, which is further supported by [31] that waiting period was less than four days for nearly two-third growers. They apply pesticides closer to harvesting time and some farmers even dip vegetable in pesticides solution after harvest [30]. In another report, author [12] stated that nearly two-third (65%) of farmers was aware of waiting period but they did not maintain the pre-harvest waiting period. In this study, the eggplant growers did not care of adequate waiting period mainly due to the fear of reduction of market value due to over maturity of the fruits and the misbelieve that the aesthetic value of the product is reduced by not applying pesticides in crops approaching harvest. In addition, some eggplant growers were not aware while others had negligence.

Author [11] reported the common negligence among farmers, wholesalers and retailers regarding waiting period.

The pesticides are stored in safe places by the most of the farmers of surveyed area, while disposal practices of empty container were disappointing. Still use of empty containner in household use, throwing anywhere in soil, dhal, stream/river exists. Author [13] found disappointing both storage and disposal practice of pesticides and its container.

The awareness regarding pesticide use was more frequent with increasing level of education ($p<0.01$) that supports the result of author [13]. Younger eggplant growers concerned more on label, preventive measures, waiting period and interested to use non-chemical practices. Eggplant growers trained by a season long IPM Farmers Field School read level of pesticides ($p<0.05$) and use non-chemical means of pest management frequently ($p<0.01$) than untrained farmers. However, there was no significant difference with preventive measures and consideration of adequate waiting period even after training. There was no difference in awareness among eggplant growers having different years of farming and pesticide use experience (Table 1).

3.3 Health issues

Pesticide use in commercial farming and fresh vegetables is excessively uncontrolled and negligible percent of eggplant growers were conscious on health of their family and consumers. Present study showed that pesticide related health problems are common among vegetable growers. Among the respondents 18 percent reported headache, 14 percent eye soar/problem, 11 percent skin irritation etc. associated with pesticide use and handling. Similar record has been reported by [26] working in Nepal and India that 31 percent of farmers complained of headache, 27 percent eye irritation, 24 percent skin burning, 10 percent nausea and 9 percent dizziness associated with plant protection. Worker [28] reported that one-fifth of the farmers experienced the problems, like headache, rash, or flu-like symptoms etc. Effects on farmers' health due to increased use of pesticide have also been reported by author [3]. In Nepal, diseases, such as cancer, tumors, reproductive disorders, birth defect and other long term illness are reported to be caused by the continuous exposure to hazardous pesticides [5].

3.4 Existing management practices

3.4.1 Non-chemical practices

Over one-third eggplant growers (35%) were familiar with non-chemical methods for *L. orbonalis* management. Such practices were higher in Dhading than Bara district. The eggplant growers using non-chemical methods of *L. orbonalis* management adopted it partially and occasionally only, but not as a whole on regular basis. Similar finding was reported by [14] that farmers seldom used traditional materials and methods to manage harmful insects. Alternatives of Chemical pesticides are not readily available and total use of bio-pesticides is limited to less than 1 percent in Nepal [23]. The most commonly used non-chemical practices among the respondents were urine fermented botanicals (UFBs) by 43 percent followed by cow urine, ash and others including eggplant-coriander intercropping and *Tagetus* as border cropping (Table 2). Author [32] reported use of neem, mug-wort, chilli, garlic, tobacco, wood ash, cow urine, soap and light trap to protect the crop from insect attack. Another author [18] also accounted on some of the traditional methods adopted by very few farmers, like spreading of wood ashes and spraying cattle urine in Dhankuta and use of light and pheromone traps in Bara for some of the insect pests of vegetables. Author [10] further clarify that cultural method, like crop rotation and intercropping could manipulate the environment to make it less favorable to pests. However, non-chemical practices are not popular due to slow or no knockdown effect, consistency and difficulty felt in their availability and preparation.

3.4.2 Chemical practices

All the eggplant growers were depended on insecticides available in local markets. They were using wide range of chemical insecticides ranging from extremely hazardous to slightly hazardous (Table 3). They recognized pesticides as medicine, and the mis-belief is deeply implanted in their mind. All the pesticides were used at higher dose and frequency than requirement although; Phorate was used in lower dose, which instead of killing only sensitizes the insects. Eggplant growers treat the use of pesticides as a part of cultivation and they sprayed pesticide frequently, *i.e.* ranging from 12 to 38 times in a single crop period. The average frequency of pesticide use was higher in Bara than in Dhading district. According to Author [18] the application frequency of pesticide was 10-22 times in summer season vegetables (including eggplant) in comparison to 2-16 times in winter

vegetables in Dankuta, Baglung, Dhading and Bara districts. Author [14] reported that frequency of chemical pesticide application by majority of farmers in Dhading district is as high as 11-25 times in vegetables especially in eggplant in a single crop period. In addition, author [9] reported that eggplant received the highest frequency of pesticide use in Siraha district.

Table 1: Awareness among eggplant growers in Dhading and Bara districts, 2012

Variable	Total respondent (N = 80)	Read label (%)	Use preventive measures (%)	Consider waiting period (%)	Use non-chemical practice (%)
1. Age					
Below 25 years	14	86	79	57	57
25 to 50 years	53	43	57	17	36
> 50 years	13	31	23	0	8
Pearson χ^2		9.947 **	8.551 *	14.863 **	7.295 *
2. Sex					
Male	54	52	61	24	41
Female	26	42	42	15	23
Pearson χ^2		0.640 ns	2.507 ns	0.792 ns	2.407 *
Ecological zones					
Bara district	40	40	53	20	23
Dhading district	40	58	58	23	48
Pearson χ^2		2.452 ns	0.202 ns	0.075 ns	5.495 *
3. Educational level					
Illiterate	20	20	30	5	15
Primary	13	31	38	0	23
Secondary	20	50	55	0.15	35
Higher Secondary	18	78	83	56	56
Graduate and Postgraduate	9	78	78	33	56
Pearson χ^2		17.417 **	14.212 **	20.575 **	9.343 ns
4. Pesticide use experience					
1 to 5 years	8	38	50	13	13
6 to 10 years	15	40	40	20	40
11 to 15 years	21	52	67	29	38
16 to 20 years	12	58	42	8	50
> 20 years	24	50	63	25	29
Pearson χ^2		1.432 ns	4.007 ns	2.451 ns	9.343 ns
5. Vegetable farming experience					
1 to 5 years	11	36	64	9	36
6 to 10 years	5	20	20	20	20
11 to 15 years	7	57	57	14	86
16 to 20 years	17	53	41	18	29
> 20 years	40	53	63	28	30
Pearson χ^2		2.872 ns	4.007 ns	2.245 ns	9.090 ns
6. Professional (IPM training)					
Yes	20	70	70	35	60
No	60	42	50	17	27
Pearson χ^2		2.872 *	2.424 ns	3.013 ns	7.326 **

*, ** represents the significant at $p<0.05$ and $p<0.01$, respectively; ns represents non-significant

Table 2: Non-chemical practices of *Leucinodes orbonalis* Guenee management in Dhading and Bara districts, 2012

S.N.	Non-chemical practices	Method of preparation	Dose	Frequency of application
1	Urine fermented botanicals	Collect and chopped all locally available botanicals. Allow them to ferment with cattle urine up to one month	1:4 to 1: 10 ratio	43 (n=12)
2	Cow urine*	Collection of urine from cow	1:10 ratio	14 (n=4)
3	Ash	Burning of available dried materials	Ns	11 (n=3)
4	Chinaberry fruit extract	Paste of chinaberry fruit	Ns	7 (n=2)
5	Tobacco leaf extracts	Paste of tobacco leaf	1:10	7 (n=2)
6	Local ghol	Mixture of 10 ml of each shamphoo, lemon juice, kerosene oil and 5 gm sakhkhar	1.5 ml/lt	7 (n=2)
7	Urine pesticide spray	Mix 1 litre of urine in 9 litre of pesticide spray	1:9 ratio	4 (n=1)
8	Coriander intercropping	Plant coriander on alternate row of eggplant		4 (n=1)
9	*Tagetus* border cropping	Plant *Tagetus* on the border of the field		5 (n=1)
Grand Total				100 (n=28)

* represents the use by dusting, while rest are by spraying except last two practice; Ns represents non specified (dose)

Table 3: Chemical practices of *Leucinodes orbonalis* Guenee management in Dhading and Bara districts, 2012

Group of pesticides	Common Name	Trade Name	Frequency (%)	Classification (WHO)
Benzene dicarboxamides	Flubendiamide 39.35 SC	Fame 480 SC	10 (n=14)	II
Diamides	Chlorantraniliprole 18.5 SC **	Dupont Coragen	13.57 (n=19)	III
Carbamate	Methomyl 40 SP **	Dunet	1.43 (n=2)	Ib
Herbal pesticides	Herbal product*	Tozen, Binasak	21.43 (n=30)	-
Mixture group	Chloropyrifos 50 EC + Cypermethrin 5 EC	Fighter, Noorani, Stampede, Lethal Super	15.71 (n=22)	II
	Trizophus 35 + Cypermethrin 1 EC **	Move	0.71 (n=1)	II
Neonicotinoids	Imidachloprid 17.8 SL	Anumida, Gajini, Victor	2.14 (n=3)	II
	Thiomethoxam 25 WG **	Actara	2.86 (n=4)	III
Organochlorine	Endosulphan 35 EC *	Thiodan	2.14 (n=3)	II
Organophosphates	Chloropyrifos 20 EC**	Dursban	0.71 (n=1)	II
	Dichlorovos 76 EC	Nuvan	2.14 (n=3)	Ib
	Dimethoate 30 EC	Rogor	2.14 (n=3)	II
	Phorate 10 G **	Thimet	6.43 (n=9)	Ia
	Trizophus 40 EC**	Curent, Josh	1.43 (n=2)	II
Synthetic Pyrithroids	Cypermethrin 10 EC	Anumite, Ripcord	2.86 (n=4)	II
	Cypermethrin 25 EC	Cypermethrin	1.43 (n=2)	II
	Deltamethrin 2.8 EC	Decis, Jadu	6.43 (n=9)	II
Others	-	Anta, Brobho, Tiger	6.43 (n=9)	
Grand Total			100 (n=140)	

* Pesticides used only in Dhading district; ** pesticides used only in Bara; Pesticides without asteric used in both district.

Earlier synthetic pyrithroids, organophosphates [14, 27] and organochlorines [34, 18] were used with increased dose and frequency to protect the crops. However, in the present study, eggplant growers were found using mostly the newer group of chemicals. This might be due to the advice they receives from the pesticide dealer/retailer and effectiveness of newer group over older probably due to development of resistance in pest for older groups of pesticides.

In the present study, the most used category of pesticide were of class II followed by unknown herbal product, pesticides belonging to class III and class I of WHO classification. In the same way, author [31] reported that half of the farmers were using Class II category of pesticides (50%), followed by unhazardous (27.80%), class I (16.70%) and class III (5.60%), respectively. Highly hazardous red label pesticides (WHO class Ia and Ib) are still in use [13]. Some eggplant growers even did not know what type of pesticides they were using. Most of the eggplant growers of Dhading have willingness to pay for alternatives but unavailability of those materials enforced them to use even hazardous group of pesticides. The intensive use of pesticide is due to either compulsion or lack of knowledge [16].

The uses of unregistered pesticide were also common on both the surveyed areas. This may be due to the illegal import of pesticides. Author [23] reported that country's physical situation as the major limitation for illegal entry of the chemical pesticides. This may be due to the open border with India as well as ineffective monitoring from the concerned authorities.

4. Conclusions

Awareness of eggplant growers on correct use and handling of pesticides in the surveyed area was poor. They are indiscriminately using pesticide with combination of some non chemical practices for the management of *L. orbonalis*, which is causing the health related problems. The proper storage as well as disposal practices of empty containers of pesticides was poor. Even highly toxic pesticides were used with very minimal precautionary measures. So, development of alternatives of chemical pesticide including indigenous/non-chemical knowledge and practices needs to be scientifically validated and effectively disseminated and awareness against unintended adverse effect of the hazardous chemical pesticides needs to be created through campaigns and training and effective enforcement of pesticide rules and regulations are urgently needed to address the existing problems associated with pesticide use.

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