ACADEMIC INN INTERNATIONAL

SOUTH ASIAN JOURNAL OF DEVELOPMENT RESEARCH

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To cite the article: Mithun Kumar Ghosh , Md. Shawkat Zaman , Md. Maruf Raihan, Md. Jahangir Alom , and Suravy Yeasmin Setu (2019). Farmers knowledge to the effect of chemicals in mango production: a case study in Chapainawabganj *South Asian Journal of Development Research*, 1(1): 124-133

Link to this article: http://aiipub.com/journals/fsajdr-190930-021027/

Article QR

Journal QR

FARMERS' KNOWLEDGE TO THE EFFECT OF CHEMICALS IN MANGO PRODUCTION: A CASE STUDY IN CHAPAINAWABGANJ

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ARTICLE INFO

Article Type: Short communication
Received: 29, Sep. 2019.
Accepted: 30, Sep. 2019
Published: 30, Sep. 2019

Keywords:

Mango Cultivation, Knowledge, Mango Growers, Chemicals, Effects

ABSTRACT

This study was conducted to assess the present scenario of chemical uses during the cultivation period of mango in Shibganj Upazila and Nawabganj Sadar Upazila in Chapainawabganj district. A total number of 40 mango growers were randomly selected and interviewed by pre-structured questionnaires from December 2018 to January 2019. The data were collected with respect to their age, educational level, cultivating land, times and types of chemicals used, and farmer's consciousness about the excessive use of chemicals in mango. Out of the 40 mango growers, about 80% were under middle-aged category, 6 were illiterate which accounts almost 15%, 8 had primary education, 14 had secondary education, 4 had higher secondary education and 8 (20%) had higher education. Around 0.13-1.33 ha of land was used by 16 (40%) mango growers for cultivation followed by 1.47-2.67 ha by 55% and more than 2.67 ha by 5% of the respondents. Twelve insecticides and twenty-three fungicides under different trade name were most commonly sprayed at 3, 5, and even more than 10 times in the stage of before flower bud initiation, mango flowering, marble-size mango, and finally till ripening stages. Most importantly, 34 (85%) showed medium knowledge and 6 (15%) had high knowledge about the chemicals, environment, health, pest management, production technology, the harmful effect of chemicals in plants and beneficial effects of chemicals in mango production. Farmers were found highly dependent on chemicals for pest management.

1. INTRODUCTION

Mango is one of the major fruits of Asia and this fruit has its own importance all over the world. It is one of the most delicious and nutritious fruits in the world. Mango belongs to the dicotyledonous family Anacardiaceae and genus *Mangifera* which contains 69 species; from them almost all the commercial cultivars of mango are included in single species *Mangifera indica.* Mango is a cross-pollinated allopolyploid crop having chromosome number 2n=40. It is grown in many subtropical and tropical countries around the world like India, Brazil, Pakistan, Mexico, Indonesia, Thailand, Philippines, China and Bangladesh.

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Mango is one of the most important tropical fruits of the world and is called as "king of fruits". It is grown more than 85 countries in the world (Takele, 2014). Bangladesh is one of the major mango producing countries (Alexander, 1989). In Bangladesh, it covers an area of 37,830 hectares of land with a yearly production of 11, 61,685 metric ton (BBS, 2016; Sultana et al. 2018).

The rank of Bangladesh in mango production is third among the tropical fruits grown in the world with total production at nearly 35,000,000 tons (FAO, 2009). Furthermore, its mango rank is second in terms of area and occupies the third position in production among the fruits grown in Bangladesh (Kobra *et al.*, 2012). The leading mango growing districts are Nawabganj, Rajshahi, Rangpur, Dinajpur and Kushtia. In the year 2010-2011, Bangladesh produced around 1.05 millions of tons of mango (UN FAOSTAT, 2011). It is the leading seasonal cash crop of the northwestern region of Bangladesh and dominates the economy in Chapainawabganj and Rajshahi district. About 85% people of the mentioned districts are directly or indirectly rely on mango cultivation and business (Dhaka Tribune, 2018).

However, Chapainawabganj district is the largest mango cultivated area in Bangladesh. The major cultivar commercially grown under Chapainawabganj are Khirsapati, Langra, Fajli, Awsshina etc. Most of the agricultural lands of this district are occupied by mango orchards. Chapainawabganj alone produced almost 152,285 MT of mangoes on 44,430 hectares of land (BBS, 2015).

The total area of this district is 1702.64 square Km, where 42263 acres are used for mango cultivation and 224764 metric tons' mango is produced per year (District Statistics, 2011), which contribute 23.78% of the Bangladesh total production. The mango is the most delicious and nutritious fruits in the world. However, attack by insects/pests is one of the most important hurdles in the massive production of mango. Insect pests and diseases not only reduce the yield but also sometimes account for a complete crop failure (Alam SN, 2011). Considering the above fact, toxic synthetic chemical pesticides have widely been used in Bangladesh to reduce the early fall out of mangoes and to increase the yield. However, pesticides are often used indiscriminately and frequently at a very high concentration without knowing the actual purpose of the pesticide being applied. Mango production knowledge and technological gaps of smallholder farmers are common in many countries (Dessalegna *et al.*, 2014). Consequently, the surrounding environment is polluted which also has an adverse effect on human health. Moreover, pesticide adulteration by wholesalers and retailers is a growing concern of many mango growers who are unsure whether insects are becoming more insecticide-resistant or insecticides are being adulterated to the point of ineffectiveness. In most cases, mango growers use pesticides in their fields based on recommendations and advice from their local pesticide dealers. However, the dealers, in general, are not expert personnel. The control of insect attack and fungal diseases are the emerging issues to protect premature mango fall out not only in Chapainawabganj district but also in all over the country. The insect and fungal attack play a negative role in the low yield and poor quality mango production. Mango can be attacked by a plethora of insect pests, however, mango hoppers, fruit fly, mango leaf cutting weevil, mango fruit borer etc. are also considered as the major constraints of low yield mango production. In the present study, a survey on mango cultivation has been conducted in Chapainawabganj Sadar Upazila & Shibganj Upazila of Chapainawabganj district which is the largest mango production area of Bangladesh. Therefore, the objectives of the present research were

- To list down the chemicals used in the study area; and
- Farmers' knowledge to the effects of chemicals used in mango production.

2. MATERIALS AND METHODS

2.1. Study Area

The study was conducted in Nawabganj Sadar upazila & Shibganj Upazila of Chapainawabganj district. However, the study was in Haripur, Jadupur (two villages in Nawabganj Sadar upazila) and Birahimpur, Mordona, Satrajitpur, Choytonnopur, Mohispur, Chokkirtti, Shampur, Bonkul, Moharajpur, Mobarakpur, Kansat, Bissonathpur, Komlakantopur villages in Shibganj Upazila. A total 40 mango growers were selected randomly from the Sadar Upazila and Shibganj Upazila of the district.

2.2. Study Procedure

The mango growers were asked face to face interview and structured questionnaire was used in this study. The quality of interview and collected data were evaluated to ensure completeness and consistency. Incomplete and inconsistent data were corrected by re-visit and re-examine the relevant mango growers. Mango growers were asked to answer, how many times they had sprayed insecticides and fungicides in each stage, such as two, three, four, five or more than five times, and name of chemicals they use. To determine the knowledge of mango growers, 21 questions were asked regarding the chemicals, environment, health, pest management, production technology, the harmful effect of chemicals in plants, beneficial effect of chemicals in mango production. Each question contains 2 marks; they are marked (0-2) marks according their answer. We categories the knowledge into three groups, Low (up to 22 marks), Medium (23-30), High (above 30). The doses and safety awareness are the prerequisites for applying insecticides/fungicides. The consciousness about the side effects and health hazards of insecticides/fungicides or any other chemicals were assessed among the mango grower and another person through questionnaire.

2.3. Characteristics of Mango Growers

Mango growers were categorized into three groups. One is based on their age (categorized as young, middle and old), level of education, which was further subdivided into five groups such as illiterate (0), primary (class 1-5), secondary (class 6-10), higher secondary (class 11-12), and above higher education. The other one is based on the land that used for mango cultivation, which was subdivided into three such as small (0.13-1.33 ha), medium (1.47-2.67 ha) and large (above 2.67 ha). Extension contact was also measured as yes, no and partly groups.

3. RESULT AND DISCUSSION

3.1. Selected Characteristics of the Farmers

The characteristics of the farmers were selected to find out their relationship with knowledge regarding the chemicals, environment, health, pest management, production technology, the harmful effect of chemicals in plants, beneficial effect of chemicals in mango production. The farmer's characteristics were age, education, farm size, extension contact. The results on the selected characteristics with the farmers are presented in Table 1.

Table 1 shows that 35% of the farmers were young, 45% were middle-aged, and 20% were old. Out of the 40 mango growers, 6 were illiterate which accounts almost 15%, 8 had primary education which accounts almost (20%), 14 had secondary education which accounts almost (35%), 4 had higher secondary which accounts almost (10%), and 8 had higher education (20%). Around 0.13-1.33 ha of land was used by 16 (40%) mango growers for cultivation followed by 1.47-2.67 ha by 22 (55%) and more than 2.67 ha by 2 (5%). Only 2 (5%) have extension contact, while 20 (50%) have no contact and 18 (45%) have partial contact.

3.2. Use of pesticides in the study area

Mango is a very vulnerable fruit to be attacked by various insects and fungus. Therefore,

recommended insecticides and fungicides spray is necessary to control insect and fungus to get better production of mango. These insecticides and fungicides spray started from mango flower (bud) until mango harvest. The mango growers frequently spray insecticides and fungicides in different stages of mango maturation without following any standard recommendations. As can be seen in table 2.

Table 1. Salient features of the respondents with their characteristics

Variable	Measuring unit	Categories	Farmers	
			No.	%
Ages	Actual year	Young(up to35)	14	35
		Middle(36-50)	18	45
		Old(above50)	08	20
Education	Year of schooling	Illiterate(0)	06	15
		Primary(class 1-5)	08	20
		Secondary(class 6-10)	14	35
		Higher secondary(class 11-12)	04	10
		Above higher	08	20
Farm size	Hectare	Small(0.13-1.33)	16	40
		Medium(1.47-2.67)	22	55
		Large(Above2.67)	02	05
Extension contact	Scale score	Yes	02	05
		No	20	50
		Partly	18	45

Table 2. List of registered agricultural pesticides used by farmers in the study area

SL. NO.	Trade Name of Products	Recommended Pests	Dosage rate/ha (ml/lt/gm/kg)	Dosage used by farmer rate/ha (ml/lt/gm/kg)
01	Sulphur 80 WP	Powdery mildew, Mites	1.25 g/L of water	
02	Kumulus DF	Powdery mildew, Mites	2.00 kg	0.1 g/l
03	Thiovit 80 WG	Powdery mildew, Mites	2.25 kg	1-8 g/l
04	Rover 80 WG	Red spider mites	2.25 kg	
05	Sayon 80 WG	Red spider mites	2.25 kg	
06	Goldvit 80 WDG	Powdery mildew	2 g/L of water	
07	Amistar Top	Anthracnose	1 ml/L of water	0.5-1 ml/L
08	Rai 325 SC	Early blight	2 ml/L of water	1-2 ml/L
09	Bavistin DF	Wilt	500 g	1 g/L

10	Knowin 50 WP	Anthracnose	1 g/L of water	2 g/L
11	Aimcozim 50 WP	Red rust	750 g	1 g/L
12	Nayan 50 WP	Anthracnose	1 g/L of water	1 g/L
13	Goldazim 500 SC	Powdery mildew	1 g/L of water	1 g/L
14	Ecozim 50 WP	Powdery mildew	1 g/L of water	1 g/L
15	Cuptun 50 WP	Rust	1 g/L of water	1 g/L
16	Curate 50 WP	Blight	2 g/L of water	1 g/L
17	Corozeb 80 WP	Blight	2 g/L of water	2 g/L
18	Kusum 80 WP	Blight	2 g/L of water	2 g/L
19	Ridomil Gold MZ 68 WG	Blight	2 g/L of water	2 g/L
20	Tilt 250 EC	Anthracnose & Powdery mildew	0.5 ml/L of water	0.5 ml/L
21	Antracol 70 WP	Die back, Black rot, Grey brown bilght,Red rust	2 kg/Lof water	2.5-5 g/L
22	Nativo 75 WP	Anthracnose	0.5 g/L of water	0.5-7 g/L
23	Trooper 75 WP	Anthracnose	2 g/Lof water	2 g/L
24	Sevin 50 WP	Hopper	4 g/L of water	2 g/L
25	Ripcord 10 EC	Hopper	1 ml/L of water	1 ml/L
26	Fencord 10 EC	Shoot fruit borer& Fruit fly	2 ml/L of water	1 ml/L
27	Typer 10 EC	Hopper	1 ml/L of water	1 ml/L
28	Decis 2.5 EC	Shoot & fruit borer	1 ml/L of water	1-4 ml/L
29	Tiddo 20 SL	Termites	7 ml/L of water	1 ml/L
30	Gain 20 SL	Termite	1.00 L	1-1.5 ml/L
31	Confidor 70 WG	Hopper	2 g/L of water	1 ml/L
32	Karate 2.5 EC	Hopper	1 ml/L of water	1 ml/L
33	Fighter 2.5 EC	Hopper	1 ml/L of water	1 ml/L
34	Kick 2.5 EC	Aphid	1 ml/L of water	1 ml/L
35	Actara 25 WG	BPH	60 g	0.1 g/L

Twelve insecticides and twenty-three fungicides under different trade names were most commonly sprayed at 3, 5, and even more than 10 times in the stage of before flower bud initiation, mango flowering, marble-size mango, and finally till ripening stages. The most commonly used some fungicides like Nativo, Antracol, Theovit, Seven powder, Amistar Top, Knowing etc. and Insecticides like Decis, Gain, Ripcord, Karate, Actara etc.

3.3. Use of growth regulator in the study area

Table 3. List of registered Plant Growth Regulator (PGR) used by farmers

SL. NO.	Trade Name of Products	Name of Registration Holder	Dosage rate/ha (ml/lt/gm/kg)	Dosage used by farmer rate/ha (ml/lt/gm/kg)	Effectiveness
01	Cultar	Syngenta	250 g/l	100 g/l	Growth Retardants
02	Protozim	Syngenta		2 ml/l	Prevent immature fruit drops
03	Flora	ACI Crop Care		3 ml/l	Growth Regulator
04	Mirakulan	Auto Crop Care Limited	0.5-1 ml/l	1 ml/l	Growth Regulator
05	Biovit	Sweet Agrovet Limited	2 ml/l	2 ml/l	Growth Regulator

Data contained in table 3 indicated that most of the farmers in the study area used Cultar in soil or in direct xylem of the root by removing the phloem in the month of August. It is growth retardants. Though it is not permitted by the govt. of Bangladesh but farmers use it secretly. As the price of Cultar is very high (10000 tk/l), farmers use it in underdose. Farmers also used other PGR like Flora, Protozim, Biovit, Mirakulan etc. after 40-50 days of fruit setting, which increase fruit weight, size and prevent premature fruit drops and Cracking.

To produce flower, a bud should enough mature about 7-8 months. If the majority percent of bud produce three times new shoot; it will not get enough time for maturation to produce flower. To control this phenomenon farmers (30%) used Cultar in the month of August as a growth retardant which enhances profuse flowering even flower come out from stem. Which also overcome alternate bearing. We found that farmers used under dose of Cultar. As it is not registered by Bangladesh government, they collected it top secretly and do not follow the proper application method. They used it in direct xylem of root by removing the phloem. But repeated phloem removing from root in several years hamper the natural healing process. If the large roots fail to heal the removed phloem or microbial pathogenic rotting occur, the root suffers in food deficiency for long run and finally certain portion of a tree or whole tree dies. If severe surface root pruning occurs for intercultural operation, it also harmful to the feeder root to the surface of the plant. Satyendra Singh Narvariya and C.P. Singh (2018) found cultar is most commonly used for the induction of flowering in off season, control tree vigour for HDP (canopy managment), increase fruit set and yield, improve fruit quality when applied to the soil but has the drawback of relatively high persistence in both soil and fruit in mango.This is alarming issue for the owner of the orchard, but not concerning issue to the grower who leases the orchard for a certain period. If the Cultar uses increase continuously in every year, the growth is drastically reduced for plant.

3.4. Spraying of chemicals

Table 4. Number of sprays to the mango trees during production

Insecticide or fungicide sprayed before flower bud initiation	**Farmers**		**No. of spray**
	No.	**%**	
	28	70	2
	10	25	1
	2	5	0
On the inflorescence before flower opening	**No.**	**%**	**No. of spray**
	12	30	2
	24	60	1
	4	10	0
Applied chemical in marble size mango setting	**No.**	**%**	**Days after interval**
	22	55	10
	12	30	15
	6	15	20
Applied PGR & Micronutrient after 40-50 days of fruit setting	**No.**	**%**	**No. of spray**
	28	70	1-2 times
	12	30	0 times
After marble size to till ripening	**No.**	**%**	**No. of application**
	22	55	3-5
	12	30	6-8
	6	15	>8
Using Cultar on the soil	**No.**	**%**	**Yes or No**
	12	30	Yes
	28	70	No

Table 4 explains that the mango growers frequently sprayed insecticides and fungicides in different stages of mango maturation. As can be seen in Table, at the stage of before flower bud initiation 70% mango growers sprayed 2 times, 25% sprayed 1 time and 5% growers did not spray. At the stage of the inflorescence before flower opening, 30% mango growers sprayed insecticides/fungicides for 2 times, 60% sprayed for 1 time and 10% never sprayed. Applied chemical in marble size mango setting 22 (55%) mango growers sprayed insecticides/fungicides 10 days' intervals, 12 (30%) mango growers sprayed insecticides/fungicides 15 days' intervals and 6 (15%) mango growers sprayed 20 days interval. Application of PGR & Micronutrient after 40-50 days' fruit setting 28 (70%) growers used 1-2 times, 12 (30%) growers used 0 times spray. After marble size to till ripening, 55% growers used 3-5 times, 30% used 6-8 times and 15% growers used more than 8 times application. Out of 40 growers, 12 (30%) used Cultar and 28 (70%) growers did not use it.

3.5. Knowledge of the mango growers to chemicals

Data presented in table 4 indicated that Most 85% of the respondents had medium knowledge with 15% having high knowledge about the chemicals, environment, health, pest management, production

technology, harmful effect of chemicals in plants and beneficial effect of chemicals in mango production. The mean was 29.18.

Table 5. Knowledge of the respondents to different chemicals

	Measuring unit	**Categories**	**Farmers**		**Mean**
			No.	**%**	
Knowledge	Scale score	Low (up to 22)	00	00	29.18
		Medium (23-30)	34	85	
		High (above 30)	6	15	

Now a day's intensive agriculture becomes popular in our country day by day. According to their mango variety and age of the plant, they use fertilizer in the soil like NPK (8-10 kg/ large tree and 2-4 kg/ medium tree), Boron, Magnesium etc. for better yield and growth of plant. They apply all fertilizer in soil after harvesting of mango in the month of august, as natural rainfall occur no irrigation needed. As mango plant does not show quick response in organic manure, so, farmers are not interested to use the organic manure in the soil.

Mango plant prefers dry and cool weather and less moisture during flower bud initiation but we found that before flowering, farmers applied irrigation one time in January and then according to the environmental condition they further irrigated in March and April up to 3-4 times in total mango production period by ring method.

Farmers had medium knowledge regarding the chemicals used for pest management. Pesticide company does not provide information on their product packet regarding the harmful effect of chemicals in plants. So, farmers do not have any knowledge of the harmful effect of chemicals in plants if overdoses used.

Farmers were less aware of their health during spray operation, they only used face mask, long shirt, long pant and cap for their protection to chemical exposers. They were unknown about the suitable part of the day for spray, they sprayed morning to evening as they hire the laborer for whole day. They did not dispose the pesticide container or packets while throwing to the open field.

They received consultation about the pesticides from the retailers and neighbors. As a result, they mistake proper selection of pesticide which also used for other crops like (Cereals and Vegetables) and applies same group pesticide under different trade name which causes economic losses and increases cost of production.

4. CONCLUSION

- Majority of the respondents were middle age, about half of them had below secondary education, around 90% had small to medium farm size and most of them did not have extension contact.
- Cultar was most frequently used among 35 chemicals found in the study area including Flora, Protozim, Biovit, Mirakulan etc.
- Most of the mango growers showed medium knowledge about the chemicals, environment, health, pest management, production technology and harmful effect of chemicals.

ACKNOWLEDGEMENTS

The author was grateful to the students of Faculty of Agriculture, EXIM Bank Agricultural University

Bangladesh (EBAUB) for their amiable assistance to make the current research successful as well as thankful to authorities of EBAUB.

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