Farmers' Weed Management Practices in Green Gram-based Cropping Systems in Central Dry Zone of Myanmar

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Abstract

The aim of this study was to observe the farmers' practices for weed control in green gram cultivation in the Central Dry Zone of Myanmar. Individual interviews were conducted in 15 villages from Tatkon and Magway townships during 2015. Random simple sampling was used to select 73 green gram growers from Tatkon township and 81 growers from Magway township. Survey data analysis were done by descriptive statistics. Farmers in the study areas commonly practised a total of ten green gram-based cropping patterns. The majority of farmers practiced green gram – rice pattern (pattern-1) in Tatkon lowland, green gram – vegetable pattern (pattern-7) and green gram – cotton pattern (pattern-8) in Tatkon upland, and sesame – green gram pattern (pattern-9) in Magway upland area. Majority of respondents in the study areas traditionally practised inter-cultivation with animal drawn implements and hand weeding. Only a few farmers in both regions used chemical combined with manual control. Nobody in both regions used chemical control alone. Although one time of inter-cultivation and one time of hand weeding in Tatkon and three times of inter-cultivation and two times of hand weeding in Magway were mainly practised, most of farmers in Tatkon practised hoe weeding as additional methods. Frequencies of weeding among the study areas were different depending on type of intercrops and weed density in the field. This difference was found not only in all patterns but also within a pattern.

Key words: cropping systems, green gram, weed control, farmers' practices, central dry

Introduction

Of the 24 million ha of agricultural land in Myanmar under cultivation, pulses are the second most important group of crops after rice with production of 5.99 million MT from 4.55 million ha (MOAI 2015). Cultivation of food legumes in Myanmar largely depends on soil moisture and temperature. Legumes are primarily grown by small-holder farmers with minimal inputs. Lack of high yielding cultivars, good quality inputs and the management of biotic and abiotic stresses are the major constraints to legume production in Myanmar (ACIAR 2011). Weeds reduce crop quality; compete with crop for mineral nutrient thereby causing reduction in crop yield quantity (Peterson 2005). The decrease in mungbean productivity due to weed competition was 45.6% (Pandey and Mishra 2003). Dry weight of weed increases as the duration of weed competition increases in crop. Weeds compete with main crop for space, nutrients, water and light (Islam et al. 1989). Thomas et al. (eds.2002) stated that weed control is essential for successful crop production, as weeds are ever present in the soil and can potentially reduce crop yields every year. Weed populations in a field are relatively constant from year to year, whereas insect and disease outbreaks, although they can have dramatic effects, can be sporadic.

Farmers can plan a weed management program based on prior knowledge of the weeds to expect. The six main areas of weed control tactics are (1) scouting, (2) prevention, (3) mechanical practices, (4) cultural practices, (5) biological control, and (6) chemical control (Ashton 1991). Timely weed control should aim at minimizing weed interference with crops at critical period in order to reduce yield losses. Intercropping is a cultural practice which increases competition between crops and weeds. It can increase light interception in a weakly competi-

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tive crop and can contribute to weed suppression in a long-term strategy for weed management (Baumann et al. 2001). Integrated weed management encompasses all techniques that are used in cropping systems so as to minimize the effect of weed interference in crop yield and also reduce the impact of crop production on the environment (Swanton and Wiese 1991).

For optimum green gram production, emphasis should be placed on strategies for combating the weed menace at minimal costs. There is dearth of information on the dominant weed control method in legume production in Central Dry Zone of Myanmar. Therefore, this study was carried out to observe weed control strategy practised by green gram farmers in Dry Zone area of Myanmar.

Materials and Methods

The study was conducted in Tatkon and Magway township of the central dry zone area. The climate of the study area is tropical with an average temperature of 33°C in Tatkon and 35°C in Magway. Tatkon Township is located at 20° 20′ N latitude, 96° 30′ E longitude and altitude 139.598 m. Magway Township is located at 20° 09′ N latitude, 95° 11′ E longitude and altitude 76.2 m. To collect information about weed control in green gram cultivation, these areas were selected based on the criteria of rain-fed condition and green gram-based cropping pattern. A total of 154 farmers from 15 villages in 2 townships (73 farmers from Tatkon and 81 farmers from Magway) were randomly sampled and interviewed using questionnaires to elicit information from farmers. The data were analyzed by the Statistical Package for Social Science Program (SPSS) version 17.0 software. Descriptive statistics were used to identify demographic characteristics, farm ownership and weed management system of sample respondents.

Results and Discussion

Personal Characteristics of Respondents

The majority of the farmers in the study areas were male. About half of the farmers were above 50 years old in Tatkon whereas more than 50% were within the age range of 26-50 years in Magway (Table 1). Farmers in Tatkon (78.1%) and Magway (58%) had more than 20 years of farming experiences. The majority of farmers in both study areas had primary level education. About 67% of farmers in Tatkon and 75% in Magway had more or less five family members per household. Most of the farmers sampled in Tatkon (45.1% and 61.3%) respectively cultivated between 1 to 3 ha of lowland and upland farms. The majority of the farmers in Magway (59.3%) cultivated between 4 to 6 ha of upland farm. An overview showed that most of the sampled respondents in the study areas were poor resources farmers. They have spent many years in their farm work, and they had low level education.

Table 1. Personal characteristics of farmers in

Characteristics	% Respondents	
	Tatkon (n=73)	Magway (n=81)
Gender		
Male	67 (91.8)	75 (92.6)
Female	6 (8.2)	6 (7.4)
Age (Years)		
≤ 25	1 (1.4)	2 (2.5)
26-50	33 (45.2)	47 (58)
> 50	39 (53.4)	32 (39.5)
Education Level		
None		
Informal	3 (4.1)	1 (1.2)
Education	12 (16.4)	7 (8.6)
Primary School	25 (34.2)	29 (35.8)
Middle School	20 (27.4)	22 (27.2)
High School	10 (13.8)	13 (16.0)
Graduate	3 (4.1)	9 (11.1)
Household Size		
≤5	49 (67.1)	61 (75.3)
6-10	24 (32.9)	20 (24.7)
Lowland Farm Size (ha)		
<1	31 (43.7)	0
1-3	32 (45.1)	0
4-6	8 (11.2)	0
Upland Farm Size (ha)		
<1	19 (30.6)	4 (4.9)
1-3	38 (61.3)	29 (35.8)
4-6	5 (8.1)	48 (59.3)
Farming Experience(yr)		
5	2 (2.7)	2 (2.5)
6-10	5 (6.9)	11 (13.6)
11-15	2 (2.7)	8 (9.9)
16-20	7 (9.6)	13 (16.0)

Table 2. Cropping patterns in the study areas

Cropping Pattern	Tatkon lowland (n=71)	% Respondents
Pattern 1	Green gram - Rice	33 (47)
Pattern 2	Green gram - Rice - Chickpea	10 (14)
Pattern 3	Green gram - Rice - Black gram	11 (15)
Pattern 4	Green gram - Rice - Vegetable	7 (10)
	other	10 (14)
	Tatkon upland (n=64)	
Pattern 5	Green gram - Sesame	7 (11)
Pattern 6	Green gram - Lablab bean	8 (13)
Pattern 7	Green gram - Vegetable	15 (23)
Pattern 8	Green gram - Cotton	14 (22)
	Other	20 (31)
	Magway upland (n=81)	
Pattern 9	Sesame - Green gram	54 (66.7)
Pattern 10	Peanut - Green gram	27 (33.3)

Therefore, transfer of new farming technology would be limited even though they were very familiar with traditional farming works.

Cropping Patterns in the Study Areas

A total of ten main green gram-based cropping patterns were observed in Tatkon lowland area, Tatkon upland area and Magway upland area (Table 2). Among them, three patterns were triple cropping. Majority of the patterns in the study areas were double cropping because of insufficient moisture to grow for the third crop. Sowing time of green gram was different in two regions. Green gram was grown as pre-monsoon crop in Tatkon and post monsoon crop in Magway. Among the observed patterns, the majority of farmers practiced green gram – rice pattern (pattern-1) (47%) in Tatkon lowland and green gram – vegetable pattern (pattern-7) (23%) and green gram – cotton pattern (pattern-8) (22%) in Tatkon upland, and sesame – green gram pattern (pattern-9) (66.7%) in Magway upland area. Most of the farmers in Magway grew sesame as monsoon crop because its harvest time was earlier than peanut, leaving enough moisture for succeeding crop (post monsoon crop) such as green gram.

Regarding cropping systems, sole cropping, mixed intercropping and row intercropping were observed in the study areas. About 55% of respondents in Tatkon and 58% in Magway practised sole cropping system (Table 3). Mixed intercropping was practised by 45.2% of respondents in Tatkon but no one practised this system in Magway. In contrast, row intercropping was not practiced in Tatkon, though 42% of respondents in Magway practised this system. It may be due to the fact that farmers in Tatkon grow green gram as a pre-monsoon followed by monsoon crop (rice in lowland and other sesame, beans and vegetable crops in upland). In Magway, monsoon crop (sesame or peanut) were intercropped with pigeon pea. After sesame and peanut were harvested, green gram was planted as post monsoon crop in the space freed by sesame or peanut. The greatest percentage (42.5%) of farmers grows green gram intercropped with sesame in Tatkon. The percentage of farmers who intercropped green gram with pigeon pea was the greatest (35.8%) in Magway. The choice of component crops in intercropping varies with soil types, climatic conditions, market demand, incidence of pests and many other circumstances (Mar Mar Kyu 2006).

Different sowing methods were practiced in Tatkon and Magway regions (Table 4). In Tatkon, row planting was practiced by almost all of the respondents (97%) and broadcasting was done by only 3% of respondents. Interestingly, however, broadcast sowing was previously done and row making by animal drawn intercultivator was practised by

Table 3. Cropping systems in the study areas

Cropping systems	% Respondents	
	Tatkon (n=73)	Magway (n=81
sole cropping	40 (54.8)	47 (58.0)
mixed intercropping	33 (45.2)	0.0
row intercropping	0	34 (42.0)
Crops (intercropped)		
sesame	31 (42.5)	4 (4.9)
maize	2 (2.7)	1 (1.2)
pigeon pea	0.0	29 (35.8)

Table 4. Sowing method of green gram in the study areas

Sowing method	% Respondents	
	Tatkon (n=73)	Magway (n=81)
Row planting	71 (97)	0
Broadcasting	2 (3)	0
Row after broadcasting	0	81 (100)

Table 5. Weed control practices in each pattern of the study areas

Weed control practices	% Respondents									
	Tatkon (n=73)								Magway (n=81)	
	Pattern-1	Pattern-2	Pattern-3	Pattern-4	Pattern-5	Pattern-6	Pattern-7	Pattern-8	Pattern-9	Pattern-10
Intercultivation										
None	3	0	0	0	14.3	12.5	0	0	0	0
One time	**66.7**	**70**	**90.9**	**85.7**	**85.7**	**75**	**73.3**	**71.4**	1.9	11.1
Two times	18.2	20	0	14.3	0	0	20	0	27.8	14.8
Three times	12.1	10	9.1	0	0	12.5	6.7	28.6	**70.3**	**74.1**
Hand weeding										
None	3	10	0	0	0	0	0	14.3	1.9	0
One time	**97**	**90**	**100**	**100**	**100**	**100**	**100**	**85.7**	18.5	18.5
Two times	0	0	0	0	0	0	0	0	**72.2**	**66.7**
Three times	0	0	0	0	0	0	0	0	7.4	14.8
Hoe weeding										
None	51.5	80	45.5	42.9	28.6	50	33.3	64.3	**100**	**100**
One time	48.5	20	54.5	57.1	71.4	50	66.7	35.7	0	0
Herbicide application										
No	100	100	90.9	100	100	100	100	92.9	96.3	88.9
Yes	**0**	**0**	**10.1**	**0**	**0**	**0**	**0**	**7.1**	**3.7**	**11.1**

all of the respondents in Magway. As green gram was grown as post monsoon crop in Magway, respondents had to grow this crop in time to get sufficient moisture for its germination. Therefore, they firstly broadcasted the seeds. When seedlings were about 7 days, rows were made by animal drawn inter-cultivator. Thomas et.al (2002) said that measure of weed suppression in the crop row can be obtained by burying small seedlings with soil thrown into the row by cultivation such as ridge-till which is an excellent component of a weed control program. This practice was similar to ridge till which is a tillage system involving scalping and planting on ridges built during cultivation of the previous year's crop. Although it involved in weed management practices, respondents did not recognize this practice as one of the solutions to weed problem. It can provide effective weed control, especially when combined with other available tools. Therefore, farmers are necessary to keep in mind that this cultural practice is one of the weed management practices for their crop production.

Weed Control Methods

Although weed control practices were differently operated in all patterns (Table 5), one time of inter-cultivation as well as hand weeding were usually pracitsed once per crop season of all eight patterns in Tatkon. Three times of inter-cultivation and two times of hand weeding were mainly practiced in two patterns of Magway. However, different weed control practices were observed even within a pattern. It is probably due to weed density in the field and may depend on labour availability at weeding time. In any case, different weed control practices may cause weed flora shift even in same cropping pattern. Koocheki et al. (2009) stated that different agronomic practices such as tillage and cultivation could affect weed flora and weed density.

The majority of farmers in Tatkon (98.6%) and Magway (93.8%) used manual weeding as a weed control strategy because manual weeding was very

Table 6. Methods of weed control used by green gram growing farmers in the study areas

Weed control	% Respondents	
	Tatkon (n=73)	Magway (n=81)
Manual	72 (98.6)	76 (93.8)
Chemical	0.0	0.0
Manual and chemical	(1)1.4	(5) 6.2

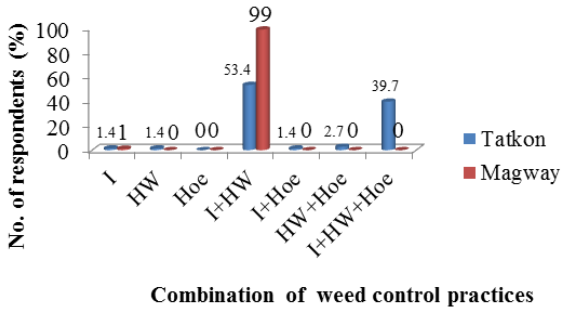

Figure 1. Combination of weed control practices in green gram based cropping patterns in study areas (HW = hand weeding, Hoe = hoe weeding, I = animal drawn inter-cultivation)

simple and easy to perform (Table 6). Only a few farmers in both regions (Tatkon – 1.4% and Magway – 6.2%) used chemical control combined with manual. Nobody in both regions used chemical control alone. In fact, the unavailability of suitable herbicides, lack of knowledge and skill in using herbicide and their worry for crop injury may be major constraints to use herbicide in green gram cultivation. Whenever farmers used herbicides in both regions, they used only pre-plant herbicide before land preparation, and said that they did not know exactly how to apply chemicals to control weeds. This may be probably due to lack of technical knowledge for the selection and application of herbicides and lack of extension service for the farmers.

Among the manual weed control methods, majority of the farmers (53%) in Tatkon practiced the combination of animal drawn inter-cultivation and hand-weeding while 99 percent of farmers in Magway practiced this combination (Figure 1). And also the combination of inter-cultivation, hand weeding and hoe-weeding was practiced by 40 percent of farmers in Tatkon. Other methods were observed as being used by very few percent of farmers. Hand-weeding, hoe-weeding and simple animal-drawn tools are the main control methods in the developing world and they dominate in low input farming (Akobundu 1998).

Intensity of Weed Control Practices

Most of the farmers (73.7% and 97%) in Tatkon practiced only one time of inter-cultivation and one time of hand weeding throughout green gram growing season while most of the farmers (71.6% and 70%) in Magway practiced three times of inter-cultivation and two times of hand weeding (Table 7). Therefore, it was observed that frequency of weeding among the study areas was different depending on weed density in the field. In case of additional weed control methods such as hoe weeding, 44% of the farmers in Tatkon needed to use hoe weeding to get the sufficient weed control. However, farmers in Magway did not need to use hoe weeding because of operating more frequency of hand weeding and inter-cultivation.

Table 7. Frequency of weeding methods in green gram-based cropping system in the study

Frequency	% Respondents	
Inter-cultivation	Tatkon (n=73)	Magway (n=81)
0	3 (4.1)	0.0
1	57 (78.1)	4 (4.9)
2	9 (12.3)	19 (23.5)
3	4 (5.5)	58 (71.6)
Hand weeding		
0	2 (3.0)	1 (1)
1	71 (97.0)	15 (19)
2	0.0	57 (70)
3	0.0	8 (10)
Hoe weeding		
0	41 (56.2)	81 (100.0)
1	32 (43.8)	0.0

In this study, most of the farmers in both areas mainly practised hand weeding. Labour scarcity may be severe in long term and weeding cannot be accomplished in time. As an alternative way for weed management, chemical control can be used to address labour scarcity although it may have a risk for environment. However, weed control techniques cannot rely solely on the use of herbicides, and integrated weed management with a major component on cultural and physical practices, should be the way to effectively reduce weed stands with minimal risk to the environment in the agriculture. FAO (1997) reported that the importance of weed management in developing countries is increasing due to the process of industrialization in several countries of the Third World, which makes labour scarce, and hand weeding still occupies more than 40% of the small farmer's time in the least developed countries

Table 8. Farmers' perception on weed problem and weed management in green gram-based

Items	% Respondents	
	Tatkon (n=73)	Magway (n=81)
1. Current weed problem		
No	30 (41.1)	14 (17.3)
Yes	43 (58.9)	67 (82.7)
2. Serious weed infestation in the past		
No	45 (61.6)	49 (60.5)
Yes	28 (38.4)	32 (39.5)
3. Causes of serious weed infestation		
Continuous raining at weeding time	23 (31.5)	26 (32.1)
Extreme hot weather at weeding time	4 (5.5)	2 (2.5)
Not available labour at weeding time	1 (1.4)	4 (4.9)
4. Awareness on integrated weed		

which does not completely prevent crop losses caused by weeds.

Farmers' Perception on Weed Problem and Weed Management

Although nearly same percentage of the farmers in Tatkon (38%) and Magway (40%) had serious weed infestation during the last five years, percentage of farmers who faced problem of weed infestation in Magway (83%) was higher than Tatkon (59%) during the year 2015 (Table 8). Farmers said that serious weed infestation was mainly due to continuous raining at weeding time.

Regarding farmers' perception on weed and crop yield, 55% and 80% of the farmers in Tatkon and Magway agreed that yield losses was due to weed infestation (Table 4.8). It was found that most farmers had a good understanding on nuisance of weed infestation and also they understood yield losses could be reduced by effective weed control practices. Apart from weed problems, farmers' another opinions about yield loss were pest infestation and adverse weather conditions such as very drought condition. Although most of the farmers in study areas were well-known to causes of yield loss, they were at low level of awareness on integrated weed management (IWM). Technology transfer of the IWM aspects to farmers is needed together with field demonstrations to adopt these practices by farmers.

Conclusion

From this study, a total of ten main green gram-based cropping patterns were common in the study areas. Among these patterns, green gram-rice (pattern-1) in Tatkon lowland, green gram-vegetable (pattern-7) and green gram-cotton (pattern -8) in Tatkon upland and, sesame-green gram (pattern-9) in Magway upland were mostly practised. The majority of farmers in the study areas traditionally practiced manual weeding such as inter -cultivation and hand weeding because they were not only traditional old methods but also more easily and available to operate than the others. Only very few farmers used both chemical and manual weed control practices because of unavailability of suitable herbicides, lack of knowledge and skill in using herbicide and their worry for crop injury. The status of weed management in the study areas was fairly poor and needs to be improved in the near future in order to increase potential crop production. Farmers should be educated to utilize all new developments on weed management in a proper manner. Therefore, extension services and training are needed to improve weed management of farmers in green gram cultivation.

Acknowledgement

This work was supported by the research grant from Australia Centre for International Agricultural Research (ACIAR), Increasing Productivity of Legume-based farming systems in the Central Dry Zone of Myanmar (ASEM-2011-047) in 2015.

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