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Assessment of Weeds and Farmers adopted Weed Control Methods in Wheat Grown Fields of West Shewa Zone, Ethiopia

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Abstract

Studies on assessment of weeds and farmers adopted weed control method in wheat fields was carried out at west shewa zone. The aim was to determine the status of weed problems and to gather information on existing farmer's indigenous knowledge regarding in wheat weed management at Ambo, Dandi, Toke Kutaye and Cheliya districts of West Shewa Zone, Ethiopia. Survey on weed problems of wheat based farming systems and farmers practices was carried out in Ambo, Dandi, Toke Kutaye and Cheliya districts of West Shewa Zone during the main rainy season of 2014/2015. Stratified random sampling technique and structured questionnaires were used to collect information on major weeds of the wheat. Grass weeds infestation and associated grain yield reduction problems were found most serious in wheat farms in the study area. *Phalaris paradoxa*, *Avena fatua*, *Bromus pectinatus* and *Snowdenia polystachya* have been found common weed species in wheat fields in the study areas. *Polypogon monspeliensis* and *Convolvulus arvensis* found to be specifically problematic weed in Ambo and Dandi area, and *Chrysanthemum segetum*, *Raphanus raphanistrum* and *Veronica* sp. in Cheliya district. Weed as main constraint and its infestation increase in the last five years having high impact on wheat production. Large proportion of the respondents ($\geq 65\%$) blamed weeds as major constraint on wheat production. Survey results indicated that about 100, 60, 97 and 30% of respondents were practicing application of herbicide, supplementary hand weeding, and crop rotation and fallowing, respectively to manage weeds of wheat in the studied districts.

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Chrysanthemum segetum, *Raphanus raphanistrum*, and *Veronica* sp.

Introduction

Ethiopia is the largest producer of wheat (*Triticum aestivum*) in sub-Saharan Africa. The current total area suited to wheat production in the country is estimated at over 1.6 million ha, with an average grain yield of 2.1 tons per hectare (CSA, 2012). Duram and bread wheat are the two major wheat varieties produced in the country, whose proportion in 1991 were about 60 and 40%, respectively. Duram and emmer wheat are indigenous to Ethiopia and have cultivated since the prehistoric period in the highlands.

Weed interference is one of the most important, but less understood factors, contributing to lowering the yields of wheat (Hassan and Marwat, 2001). Weed is the most underestimated pest in tropical agriculture, but influencing human activities more than other crop pests contributing towards lowering the harvestable yields (Akobundu, 1987). The distribution and density of weeds in an arable field is the result of ecological reactions to previous management practices, soil characteristics of the site and the regional climate (Froud-Williams *et al.*, 1983; Andersson and Milberg, 1998). Weeds not only reduce the crop yield, but also deteriorate the quality of

farm produce that trim down the market value of the grain. Although crop yield losses from weeds vary from crop to crop and from region to region, because of various biotic and abiotic factors, it has been estimated that weeds cause a yield loss of about 10% in the less developed countries and 25% in the least developed countries (Akobundu, 1987). In Ethiopia a yield loss of above 36.3% was recorded in wheat in uncontrolled plots (Rezene, 2005).

In Ethiopia the relative importance of common weed species in the major crops and cropping systems is not well documented (Stroud and Parker, 1989). Furthermore, there is no detailed information available about farmers adopted weed control methods.

Taye and Yohannes (1998) reported that weed surveys in Ethiopia in the past was general weed population reconnaissance surveys and collection, which are more qualitative than quantitative in nature. However, a quantitative weed species determination is more informative than the qualitative surveys to fully describe a weed community and establish a basis for devising appropriate weed research and management strategies.

Before going to make any decision as a solution to a weed problem it needs to make a survey in particular area to document the indigenous knowledge of the community and also to visually confirm the existing situation. Therefore, survey of weed flora composition, distribution and intensity is essential for a comprehensive understanding of the weed problem that poses negative impacts on crop production in a given area. Such assessment of the nature of weed flora determines to a large extent, the type of weed management measures to be adopted. Thus, knowledge of the weed community structure and farmers indigenous weed control practices are important components of weed management, and essential in setting priorities for both weed research and management in the future. Therefore the assessment was incited to determine the status of weed problems and to gather information on existing farmer's indigenous knowledge regarding in wheat weed management at Ambo, Dandi, Toke Kutaye and Cheliya districts of West Shewa Zone, Ethiopia.

Materials and Methods

Description of the study area

Survey was carried out in four districts of West Shewa Zone of Oromiya Regional state of Ethiopia. West

Shewa Zone is located at 8⁰17-8⁰57'N latitude and 37⁰08-38⁰07' E longitude, within altitudes ranges of 1380-3300m.a.s.l. The annual average rain fall was 1115mm. The mean maximum and minimum temperature of the area is 11.7⁰c and 25.4 ⁰c, respectively.

Survey procedure

Survey on weed problems of wheat based farming systems and farmers practices was carried out in Ambo, Dandi, Toke Kutaye and Cheliya districts of West Shewa Zone Ethiopia was carried out during the main rainy season of 2014/2015. The survey was conducted in five representative peasant associations in each district on three representative farmers' fields. A total of 160 household were randomly selected and interviewed from varied age groups, sex, educational level and marital status. Stratified random sampling technique and structured questioners were used to collect information on major weeds of the wheat, constraints of wheat productions, weed infestation scenario, impact of weed infestation, methods of weed control, ploughing frequency, sowing time, type of herbicides used, frequency of herbicide application and hand weeding, and then yield losses due to weed infestation.

Information on weed and problematic weed species encountered in the study area were collected at farmer's field by asking farmers and prioritized. Weed species were identified at field condition using existing knowledge and by using the available weed identification guides (Terry and Michiek, 1987; Stroud and Parker, 1989; McIntyre, 1991). Specimens of weed plants that could not identified during the assessment were collected and taken to center Herbarium for identification and/or sent to Addis Ababa University for Taxonomic Service. The collected data were summarized, tabulated and interpreted to sentences.

Results and Discussions

Gender, marital status and age distribution

Most of the respondent's from Ambo (73%), Dandi (80%), Toke kutaye (100%) and Cheliya (100%) districts were male. The highest female respondents were encountered in Ambo (27%) and followed by Dandi (20%) district. Thus, the cumulative results of four districts indicated that most of the respondents were male. Respectively about 60, 67, 53 and 100% of the respondents from Ambo, Dandi, Toke kutaye and

Cheliya districts were found married. On the other hand large number of the remained respondents from Ambo (40%), Dandi (20%) and Toke kutay (40%) were single. Few of respondents from Toke kutaye (7%) were divorced. Therefore, most of the study area farmers were married 70% and within the age brackets of 21-60 years 95% (Table 1).

Literacy and Educational attainment

Respondent without formal education was 33% in Dandi, 13% in Tokekutaye, 27% in Ambo and Cheliya districts

(Table 2). Considerable number of respondent from Ambo (20%), Dandi (47%), Toke kutaye (47%), and from Cheliya (73%) districts had primary education. Higher percentage of farmers 87% in Dandi and Toke kutaye, 73% in Ambo and Cheliya were found educated from primary to tertiary level.

The percentage of farmers that attained primary, secondary and tertiary level of educational was 47%, 25% and 3% respectively.

Table.1 Gender, marital statuses, and age distribution of wheat farmers

Category	Ambo		Dandi		Toke Kutaye		Cheliya		Mean (%)
	F	(%)	F	(%)	F	(%)	F	(%)	
Gender									
Male	11	73	12	80	15	100	15	100	88
Female	4	27	3	20	0	0	0	0	12
Marital status									
Single	6	40	3	20	6	40	0	0	25
Married	9	60	10	67	8	53	15	100	70
Divorced	0	0	0	0	1	7	0	0	2
Widowed	0	0	2	13	0	0	0	0	3
Age(Year)									
10-20	0	0	0	0	3	20	0	0	5
21-30	7	47	5	33	2	13	4	27	30
31-40	1	7	3	20	6	40	8	53	30
41-50	0	0	5	33	3	20	3	20	18
51-60	7	47	2	13	1	7	0	0	17
>61	0	0	0	0	0	0	0	0	0

Key: F= Frequency

Table.2 Educational qualifications of wheat farmers

Educational qualification	Ambo		Dandi		Toke Kutaye		Cheliya		Mean %
	F	(%)	F	(%)	F	(%)	F	(%)	
Illiterate	3	20	5	33	2	13	4	27	23
Basic/religion based	1	7	0	0	0	0	0	0	2
Primary	3	20	7	47	7	47	11	73	47
Secondary	6	40	3	20	6	40	0	0	25
Tertiary	2	13	0	0	0	0	0	0	3

Key: F=Frequency

Table.3 Weeds of wheat in four districts of West Shewa Zone, 2014

No	Scientific name	Ambo		Dandi		Toke Kutaye		Cheliya		Mean	
		F	%	F	%	F	%	F	%	F	%
1	<i>Phalaris paradoxa L.</i>	8	53	10	67	4	27	4	27	26	43
2	<i>Avena fatua L.</i>	6	40	10	67	9	60	8	53	33	55
3	<i>Bromus pectinatus Thinb</i>	4	27	3	20	9	60	8	53	24	40
4	<i>Lolium temulentum L.</i>	0	0	0	0	4	27	8	53	12	20
5	<i>Snowdenia polystachya (Fresen.) Pilg.</i>	2	13	8	53	6	40	4	27	20	33
6	<i>Oplis menushirtellius</i>	0	0	3	20	4	27	0	0	7	11
7	<i>Setaria pumila (Poir.) Roem. and Schult.</i>	0	0	0	0	8	53	0	0	8	13
8	<i>Convolvulus arvensis L. (Vilucchio)</i>	6	40	3	20	0	0	0	0	9	15
9	<i>Scorpiurus muricatus L.</i>	0	0	0	0	0	0	0	0	0	12
10	<i>Sonchus aspera (L.) Hill</i>	4	27	0	0	0	0	0	0	4	13
11	<i>Guizotiascabra (Vis) chiov.</i>	4	27	0	0	13	87	8	53	25	42
12	<i>Polygonum nepalense Meisn.</i>	0	0	3	20	0	0	0	0	3	5
13	<i>Scolymus moculatus (L.)</i>	0	0	3	20	4	27	4	27	12	20
14	<i>Trifolium species</i>	0	0	0	0	0	0	0	0	11	18
15	<i>Raphanus raphanistrum L.</i>	0	0	0	0	0	0	4	27	4	7
16	<i>Spergula arvensis L.</i>	0	0	3	20	0	0	0	0	3	5
17	<i>Chrysanthemum segetum (L.)</i>	0	0	0	0	0	0	4	27	4	7
18	<i>Veronica sp.</i>	0	0	0	0	0	0	11	73	11	18
19	<i>Caylusia abyssinca</i>	0	0	0	0	2	13	0	0	2	3
20	<i>Rumex sp</i>	0	0	5	33	2	13	0	0	7	12
21	<i>Erucastrum arabicum Fisch. and C.A. Mey.</i>	0	0	0	0	4	27	8	53	12	20
22	<i>Amaranthus sp.</i>	0	0	0	0	2	13	0	0	2	3

Key: F=frequency

Table.4 Constraints for wheat production

Constraints	Ambo		Dandi		Toke Kutaye		Cheliya		Mean (%)
	F	(%)	F	(%)	F	(%)	F	(%)	
Weed infestation	13	87	12	80	13	87	11	73	82
Disease	0	0	3	20	2	13	8	53	22
Environmental stress	0	0	0	0	2	13	0	0	3
Unavailability of improved seed	0	0	0	0	4	27	0	0	7
Unavailability of agrochemicals	2	13	0	0	0	0	0	0	3

Key: F= Frequency

Table.5 Weed infestation scenario in wheat fields

Weed infestation scenario	Ambo		Dandi		Toke Kutaye		Cheliya		Mean %
	F	(%)	F	(%)	F	(%)	F	%	
Increased	4	27	6	40	13	87	11	73	57
Decreased	11	73	3	20	2	13	4	27	33
Remain the same	0	0	6	40	0	0	0	0	10

Key=Frequency

Table.6 Impact of weed infestation on wheat production

Farmer perception	Ambo		Dandi		Toke Kutaye		Cheliya		Mean (%)
	F	(%)	F	(%)	F	(%)	F	(%)	
Low	2	13	5	33	0	0	0	0	12
Medium	5	33	5	33	2	13	4	27	27
High	8	53	5	33	13	87	11	73	62

Key: F=Frequency

Table.7 Farmers weed management practice

Weed control method	Ambo		Dandi		Toke Kutaye		Cheliya		Mean (%)
	F	(%)	F	(%)	F	(%)	F	(%)	
Hand weeding	9	60	5	33	8	53	14	93	60
Herbicide	15	100	15	100	15	100	15	100	100
Crop rotation	13	87	15	100	15	100	15	100	97
Fallowing	2	13	5	33	7	46.7	4	26.7	30

Key: F=Frequency

Table.8 Ploughing frequency and sowing time for wheat production

Farmer practice	Ambo		Dandi		Toke Kutaye		Cheliya		Mean (%)
	F	(%)	F	(%)	F	(%)	F	(%)	
Ploughing									
3 times	2	13	5	33	0	0	0	0	12
4 times	9	60	10	67	7	47	8	53	57
5 times	4	27	0	0	8	53	7	47	32
6 times	0	0	0	0	0	0	0	0	0
Sowing Time									
Jun 15-30	4	27	8	53	4	27	4	27	33
July 1-15	4	27	5	33	8	53	11	73	47
July 16-31	2	13	2	13	3	20	0	0	12
August 1-15	4	27	0	0	0	0	0	0	7
August 16-31	1	7	0	0	0	0	0	0	2

Key: F=Frequency

Table.9 Frequency of hand weeding and herbicide applications in wheat fields

Method of weed control	Ambo		Dandi		Toke Kutaye		Cheliya		Mean (%)
	F	(%)	F	(%)	F	(%)	F	(%)	
Hand weeding									
Once	8	53	5	33	8	53	11	73	53
Twice	0	0	0	0	0	0	4	27	7
Herbicide application									
Once	13	87	12	80	8	53	11	73	73
Twice	2	13	3	20	7	47	4	27	27

Key: F=Frequency

Table.10 Types of herbicide adopted by Wheat producing farmers

Herbicide type	Ambo		Dandi		Toke Kutaye		Cheliya		Mean (%)
	F	(%)	F	(%)	F	(%)	F	(%)	
2-4,D	15	100	15	100	15	100	15	100	100
Roundup	4	27	5	33	0	0	0	0	15
Richway750WDG	2	13	0	0	0	0	0	0	25

Key=Frequency

Table.11 Estimated yield losses in wheat in due to weed infestation

Percent yield loss	Ambo		Dandi		Toke Kutaye		Cheliya		Mean (%)
	F	(%)	F	(%)	F	(%)	F	(%)	
<20	4	27	6	40	7	47	7	47	39
20-30	2	13	0	0	4	27	4	27	17
31-40	5	33	3	20	4	27	4	27	27
41-50	4	27	3	20	0	0	0	0	12
>51	0	0	3	20	0	0	0	0	5

Key: F=Frequency

Major weeds of wheat in the study area

In the study area a total of 22 major weed species were recorded in wheat. Grass weeds infestation and associated grain yield reduction problems were found most serious in wheat farms in the study area. *Phalaris paradoxa*, *Avena fatua*, *Bromus pectinatus* and *Snowdenia polystachya* have been found common weed species in wheat fields in the study areas. *Polypogon monspeliensis* and *Convolvulus arvensis* found to be specifically problematic weed in Ambo and Dandi area, and *Chrysanthemum segetum*, *Raphanus raphanistrum*, and *Veronica sp.* in Cheliya district (Table 3). Therefore occurrence of weed species vary from area to area depend up of farmers weed management, soil and climatic factor. Similar to this result (Saavedra *et al.*, 1990) reported that Weed growth, population density and distribution vary from place to place depending upon soil and climatic factors that affect the weed flora, and farmers' management practices.

Constraints for wheat production

Constraints encountered by farmers for wheat production have been indicated in Table 4. The overall result indicated about 82% of the farmers mentioned weed as main constraint in wheat production. Moreover disease, unavailability of improved seeds, lack of agrochemicals and environmental stress were stated by 22, 7 and 3% of the respondents, respectively.

Weed infestation scenario

About 57% of wheat farmers stated an increment of weed infestation in the last five years on other hand 33% of the respondents mentioned that it has decreased and

10% of them described that it has remained the same (Table 5).

Impact of weed infestation

About 62% of the farmers stated the high impact of weed infestation on wheat production. On the other hand 27% of the respondents agree that it was medium and 12% of them described that it was low (Table 6).

Farmers weed management practice

All of the farmers interviewed in the study areas were applied 2, 4-D herbicide to control weeds of wheat fields (Table 7). In addition most of them respectively 93, 60, 53 and 33% from Cheliya, Ambo, Toke kutaye and Dandi districts were controlling weeds of wheat fields by supplementary hand weeding. All respondent farmers from Dandi, Tokkekutaye and Cheliya, and 87% from Ambo districts were practicing crop rotation. Certain respondent farmers 47% from Toke kutaye, 33% from Dand, 27% from Cheliya and 13% from Ambo were found practicing fallowing to minimize weed infestation problem. Thus, the combined results indicated that about 100, 60, 97 and 30% of respondents were practicing application of herbicide, supplementary hand weeding, and crop rotation and fallowing, respectively to manage weeds of wheat in the studied districts.

Ploughing frequency and sowing time

Farmers indigenous knowledge on weed management was differ from farmers to farmers in the study areas. Most of farmers manage their farm land by preventing weeds before spreading by sowing clean seed, practicing repeated ploughing, crop rotation and fallowing, and

controlling weeds by herbicide and supplementary hand weeding. Large proportion of the farmers 67% in Dendi, 60% in Ambo, 53% in Cheliya and 47% in Toke Kutaye districts were undertaken four times ploughing frequency for wheat production.

Considerable proportion of interviewed farmers; 53%, 47% and 26% were practiced five times frequencies in Toke kutaye, Cheliya and Ambo districts, respectively. However, 13% in Ambo and 33% in Dandi were found used three times ploughing frequency. Therefore combined result of four districts indicted that higher frequencies (57%) of farmers were undertaken four times ploughing whereas about (32%) of farmers were undertaken five times ploughing for wheat production. The combined results of study area indicated that about 92% of the farmers sow wheat between mid of June to late July (Table 8).

Frequency of hand weeding and herbicide application

Most of the farmers interviewed (73%) were found applied herbicide once to control wheat weeds whereas 27% of them applied twice at Cheliya district (Table 9). In addition, mean result indicated that 53% of wheat farmers were practicing one time hand weeding whereas 7% of them practicing twice hand weeding.

The combined result of survey data indicated that 73% of the respondents were practicing herbicide spray supplementary with only once hand weeding. Here large number of the farmers 78% were found practicing one time herbicide application whereas 18% of them make twice application (Table 9).

Type of herbicide adopted

Large number of the respondents was applied 2, 4-D for weed control in wheat while certain of them from Dandi (33%) and Ambo (27%) applied Round up, and others from Ambo (13%) applied Richway 750WDG. The mean results of four districts indicated that about 100%, 25% and 15% of farmers interviewed were applied 2, 4-D; Richway 750WDG and round up respectively for weed control in wheat (Table 10).

Yield loss due to weeds in wheat

Estimated yield loss in wheat due to weeds were less than 20% by about 38% farmers, however 27% of them stated 31-40%, 17% of them stated 20-30%, 12% of

them stated 41-50% and 5% of the farmers said greater than 51% yield losses (Table 11).

Conclusion

Grass weeds infestation and associated grain yield reduction problems were found most serious in wheat farms. *Polypogon monspeliensis* and *Convolvulus arvensis* found to be specifically problematic weed in wheat farms of Ambo and Dandi area, whereas *Chrysanthemum segetum*, *Raphanu sraphanistrum*, and *Veronica sp.* in Cheliya district. Weed as main constraint and its infestation increase in the last five years having high impact on wheat production. Farmers of the assessed area attempt different weed management practices like crop rotation, fallowing, repeated ploughing, sowing time adjustment, clean seed sowing, 2,4-D herbicide application and hand weeding for wheat production. However, no adequate access to grass killer herbicides and also morphologically mimic nature of grass weeds has made hand weeding difficult. Thus, they were found facing serious problem of grass weeds infestation and considerable wheat yield loss looking for scientifically proven weed management technologies.

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