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EFFICACY OF VARIOUS HERBICIDES FOR MANAGEMENT OF WEED FLORA IN CITRUS ORCHARDS

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ABSTRACT

To determine the efficacy of different post-emergence herbicides against weed flora in citrus orchards, experiments during July-Aug (summer) and Oct-Nov 2009 (autumn) were laid out in a randomized complete block design with three replications. The experiments comprised of five treatments including four herbicides and a weedy control. The four herbicides were glyphosate (Title 95%SG, a candidate product of the Auriga Chemicals Enterprises), glyphosate (Round up, used as standard product), gramoxone (Remote 20%SL, a candidate product of Ali Akbar Enterprises) and gramoxone (Gramoxone 200SL, used as standard product). Statistical analyses of the data indicated that the herbicides had a significant weed control and weed canopy reduction. The herbicides, Title 95%SG, Round up, Remote 20%SL and Gramoxone 20SL decreased the total weed density to 2.6, 6.5, 23.3 and 31.4 weeds m^{-2}, respectively in summer; whereas the respective values in autumn were 1.6, 1.5, 4.1 and 5.2 weeds m^{-2}. Similarly the total weed canopies were 3.0, 5.8, 10.8 and 13.2% weeds m^{-2}, respectively in summer; and 2.2, 1.4, 3.6 and 4.8% weeds m^{-2} in autumn. However, their effect on individual weeds was statistically at par. The herbicide, Title 95%SG had a statistically similar performance in comparison with that of Round up. Similarly, Remote 20%SL performed statistically at par with Gramoxone 200SL. The highest values for weed canopy coverage were in the weedy check i.e. 87% m^{-2} in summer and 83% m^{-2} in autumn; whereas lowest values were 3% and 2.2% recorded in Title 95%SG in summer and autumn, respectively. Both experiments disclosed that all the herbicides significantly decreased the canopies of all the weed species as compared to control treatment and that no injury was recorded on the citrus trees.

Key words: Herbicides, glyphosate, gramoxone, citrus, weed density, weed canopy.

INTRODUCTION

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Chemical weed control minimizes hand labor, increases tree growth, reduces damage to tree trunks, and improves movement within the grove (Jordan, 1978). When properly selected and applied for specific tree age, scion, and soil type, herbicides will not injure healthy citrus trees (Abouziena *et al.*, 2008). Positive responses in tree trunks and canopy volume have been noted when weeds were controlled which promotes greater production (Futch, 1997; Jordan *et al*., 1992).

The production from citrus orchards is a lucrative business. The wide range of soil and environmental conditions under which citrus is grown provides favorable conditions for diverse weed populations. Weed growth is undesirable because it competes with citrus trees for water, space and nutrients etc. (Neff, 1997). They provide cover for rodents and insect pests, and interfere with orchard heating, harvesting, and other cultural practices. It is inevitable to properly manage the weed infestation citrus orchards in order to protect the citrus trees from competition with persistent and pernicious weeds (Power, 1996).

There are several possible means to control the weed infestation in citrus orchards. However, the use of herbicides is the most widely accepted, efficient, and economical means of weed control in this regard. Several factors determine the selection of proper herbicide for a particular citrus orchard such as the age of the trees, the type of soil and the variety of weed growth etc. (Singh and Tan, 1992). An experiment was undertaken to identify problem weeds of citrus orchard in the Agriculture Research Institute (ARI), Tarnab, Peshawar to figure out an effective and economical herbicide and to test a couple of candidate products with standard herbicides for weed control in the citrus orchards.

MATERIALS AND METHODS

To determine the efficacy of different post-emergence herbicides against weed flora in citrus orchards, two experiments one during July-Aug and the other during Oct-Nov 2009 were laid out in a randomized complete block design with three replications. The experiments comprised of five treatments including four herbicides and a weedy control. The four herbicides were Title 95%SG (a product of the Auriga Chemicals Enterprises), Round up (a product of Monsanto Pakistan AgriTech Pvt. Ltd.), Remote 20%SL (Ali Akbar Enterprises) and Gramoxone 200SL (Syngenta). The herbicides Title 95%SG (candidate) and Round up (standard) both are non selective systemic herbicides, absorbed by the foliage with rapid translocation throughout the plant killing all the above and below ground plant parts. They are however inactivated on contact with the soil. On the other hand, the herbicides Remote 20%SL (candidate) and Gramoxone 200SL (standard) both are non selective contact herbicides that only kill the aboveground plant

parts. The individual treatment size was kept as 6m x 6m. The identification of different weeds flora was done on 16-07-2009 in the first experiment and on 7-10-2009 in the second experiment with the herbicides applied as post-emergence on the same day. The data on weed density m^{-2} and weed canopy percentage were recorded on 30-07-2009 and on 21-10-2009 i.e. two weeks after the herbicide application. For the data collection a quadrate of size of 1 m^2 was randomly thrown three times in each experimental unit and then their means were taken for further analysis of the data. No injury was observed on citrus trees in both the experiments. Details of the treatments are presented in Table-1.

Table-1. List of treatments used.

S.No.	Treatments (trade names)	Common Names	Application Time	Dose ha^{-1}
1.	Title 95% SG (candidate)	glyphosate	Post emergence	2.5 kg
2.	Round up (standard)	glyphosate	Post emergence	3.0 lit
3.	Remote 20% SL (candidate)	paraquat	Post emergence	2.5 lit
4.	Gramoxone 200 SL (standard)	Paraquat	Post emergence	3.0 lit
5.	Weedy Check	---	---	---

The following weeds were predominantly infesting the target citrus orchards i.e. *Cynodon dactylon* (Bermuda grass), *Digitaria sanguinalis* (Large crabgrass), *Cyperus rotundus* (purple nutsedge), *Setaria* sp. (Foxtails), *Anagallis arvensis* (Scarlet pimpernel), *Sorghum halepense* (Johnsongrass), *Euphorbia* sp. (spurge), *Convolvulus arvensis* (Field bindweed), and *Trianthema portulacastrum* (horse purslane). All the data taken were analyzed statistically according to the appropriate statistical technique and the significant means were separated using LSD test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Weed density m^{-2}

The data regarding weed density m^{-2} of different weed flora in the summer and autumn experiments are shown in Tables-2 and 3, respectively. Statistical analyses of the data in the two experiments indicated that the herbicides significantly controlled the weeds. The herbicides, Title 95%SG, Round up, Remote 20%SL and Gramoxone 20SL decreased the total weed density to 2.6, 6.5, 23.3 and 31.4 weeds m^{-2}, respectively in summer experiment. In the autumn experiment the values were 1.6, 1.5, 4.1 and 5.2 weeds m^{-2},

respectively. However, their effect on individual weeds was statistically at par (Tables-2 and 3). The candidate herbicide, Title 95%SG had a statistically similar performance in comparison with that of the standard herbicide, Round up. Similarly, the candidate herbicide, Remote 20%SL performed statistically at par with the standard herbicide, Gramoxone 200SL. All the herbicides considerably reduced the weed population to a significant level as compared to control treatments wherein maximum weed density of 100.8 plants m^{-2} was recorded in the summer experiment and 84.3 plants m^{-2} were recorded in the experiment conducted in autumn. All the weed species were significantly decreased with the application of herbicides as compared to the control treatments in both the experiments. Singh and Tucker (1984) also worked in the same way whereas Power (1996) reported that chemical control is the most econmical method for weed control in citrus production.

Weed canopy (%)

The weed canopies are shown in Tables-4 and 5. All the herbicides had a highly significant effect on weed canopy reduction. Title 95%SG, Round up, Remote 20%SL and Gramoxone 200SL reduced the total weed canopies to 3.0, 5.8, 10.8 and 13.2% weeds m^{-2}, respectively in experiment 1; whereas the respective values in experiment 2 were 2.2, 1.4, 3.6 and 4.8% weeds m^{-2}. The effect of the herbicides among themselves was however at par (Table-4 and 5). The performance of the candidate herbicide, Title 95%SG was statistically similar to that of Round up, used as standard herbicide. Similarly, the performance of the candidate herbicide, Remote 20%SL in comparison with the standard herbicide, Gramoxone 200SL was statistically at par. Weed canopy coverage was maximum i.e. 87% m^{-2} recorded in the weedy check plots in summer and 83% m^{-2} in the autumn; whereas minimum weed canopy i.e. 3% recorded in Title 95%SG treatments in summer and 2.2% in autumn. Hence Title 95%SG proved the best in reducing the weed canopies however it was statistically similar with the rest of the herbicides. Both experiments disclosed that all the herbicides significantly decreased the canopies of all the weed species as compared to the control treatments. The results of Neff (1997) indicated that the use of herbicides is important in citrus orchards; however some leguminous species, such as perennial peanuts, should be used as a tool for integrated management of weeds. Singh and Tucker (1984) mentioned that the use of non selective herbicides with least residual effect is the best option in citrus orchards. It is the most economical method for weed control in citrus production (Power, 1996).

Table-2. Different weed species m^{-2} as affected by weed control treatments in citrus orchard in summer season during the year 2008-09.

Treatments	*Cynodon dactylon*	*Digitaria sanguinalis*	*Cyperus rotundus*	*Setaria* sp.	*Sorghum halepense*	*Convolvulus arvensis*	*Trianthema portulacastrum*	Total weeds
Weedy control	14.3 a	27.1 a	18.8 a	14.7 a	8.6 a	8.3 a	9.0 a	100.8
Title 95% SG	0.9 c	0.4 c	0.2 e	0.3 b	0.8 c	0.0 b	0.0 b	2.6
Round up	2.0 bc	1.3 c	0.4 d	0.7 b	1.8 bc	0.3 b	0.0 b	6.5
Remote 20% SL	3.0 bc	5.7 bc	5.8 c	2.3 b	5.2 ab	0.7 b	0.6 b	23.3
Gramoxone 200SL	5.3 b	8.8 b	8.7 b	2.6 b	4.3 abc	1.0 b	0.7 b	31.4
$LSD_{0.05}$	**4.2**	**6.5**	**2.6**	**4.9**	**4.4**	**2.1**	**2.4**	

Means not sharing a letter differ significantly by LSD at 5 % probability level.

Table-3. Different weed species m^{-2} as affected by weed control treatments in citrus orchard in autumn season during the year 2008-09.

Treatments	*Sorghum halepense*	*Cynodon dactylon*	*Convolvulus arvensis*	*Digitaria sanguinalis*	*Setaria* sp.	*Euphorbia* sp.	*Cyperus rotundus*	Total weeds
Weedy control	8.3 a	14.0 a	12.0 a	9.7 a	16.6 a	14.7 a	9.0 a	84.3
Title 95% SG	0.4 b	0.7 b	0.3 b	0.0 b	0.2 b	0.0 b	0.0 b	1.6
Round up	0.8 b	0.7 b	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b	1.5
Remote 20% SL	1.0 b	1.7 b	0.0 b	0.4 b	0.0 b	0.0 b	0.7 b	4.1
Gramoxone 200SL	1.0 b	1.6 b	0.8 b	0.0 b	1.0 b	0.0 b	0.8 b	5.2
$LSD_{0.05}$	**3.0**	**6.1**	**3.1**	**4.8**	**7.4**	**3.1**	**2.0**	

Means not sharing a letter differ significantly by LSD at 5 % probability level.

Table-4. Canopy coverage (%) of different weed species m^{-2} as affected by weed control treatments in citrus orchards in summer during the year 2008-09

Weeds	Weedy control	Title 95% SG	Round up	Remote 20% SL	Gramoxone 200SL	LSD
Cynodon dactylon	17.3 a	1.5 c	2.3 bc	2.4 bc	3.9 b	2.4
Digitaria sanguinalis	12.1 a	0.3 c	0.8 bc	1.8 bc	2.1 b	2.0
Cyperus rotundus	15.7 a	0.3 c	1.2 bc	2.7 bc	2.9 b	2.7
Setaria sp.	7.3 a	0.5 b	0.3 b	1.1 b	1.2 b	1.4
Sorghum halepense	14.3 a	0.4 c	1.0 bc	2.2 b	1.3 b	1.7
Convolvulus arvensis	11.0 a	0.0 b	0.2 b	0.2 b	1.1 b	1.8
Trianthema portulacastrum	9.3 a	0.0 b	0.0 b	0.4 b	0.7 b	1.2
Percent canopy of all weeds	87.0%	3.0%	5.8%	10.8%	13.2%	

Means not sharing a letter differ significantly by LSD at 5 % probability level.

Table-5. Canopy coverage (%) of different weed species m^{-2} as affected by weed control treatments in citrus orchards in autumn during the year 2008-09

Weeds	Weedy control	Title 95% SG	Round up	Remote 20% SL	Gramoxone 200SL	LSD
Sorghum halepense	9.0 a	0.3 b	0.7 b	1.0 b	1.3 b	3.6
Cynodon dactylon	14.7 a	0.7 b	0.7 b	1.0 b	1.5 b	3.9
Convolvulus arvensis	12.3 a	0.7 b	0.0 b	0.0 b	1.0 b	4.2
Digitaria sanguinalis	10.7 a	0.0 b	0.0 b	0.7 b	0.0 b	4.9
Setaria sp.	12.3 a	0.2 b	0.0 b	0.2 b	0.3 b	2.9
Euphorbia sp.	9.3 a	0.0 b	0.0 b	0.0 b	0.0 b	1.9
Cyperus rotundus	15.0 a	0.3 b	0.0 b	0.7 b	0.7 b	1.4
Percent canopy of all weeds	83.3%	2.2%	1.4%	3.6%	4.8%	

Means not sharing a letter differ significantly by LSD at 5 % probability level.

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