Available Online at http://www.journalajst.com

ASIAN JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN: 0976-3376

Asian Journal of Science and Technology
Vol. 09, Issue, 05, pp.8216-8218, May, 2018

RESEARCH ARTICLE

EFFECT OF WEED MANAGEMENT SYSTEMS ON TOMATO (*LYCOPERSICON ESCULENTUM* MILL.) YIELD IN HERAT PROVINCE, AFGHANISTAN

[1,*]Obaidullah GHAFORY, [2]Ricky E. FOSTER, [3]Stephen C. WELLER and [4]Kevin T. MCNAMARA

[1]Department of Agronomy, Herat University, Herat, Afghanistan
[2]Department of Entomology, 901 W. State Street, Purdue University, W. Lafayette, IN, USA
[3]Department of Horticulture and Landscape Architecture, Purdue University, W. Lafayette, IN USA
[4]Department of Agricultural Economics, Purdue University, W. Lafayette, IN USA

ARTICLE INFO

Article History:
Received 15th February, 2018
Received in revised form
19th March, 2018
Accepted 10th April, 2018
Published online 30th May, 2018

Key words:
Tomato, Weeds, Mulch,
Glyphosate, Metribuzin.

ABSTRACT

Various weed management techniques were compared for efficacy and effect on tomato yield in 2014 field studies in Herat, Afghanistan. All weed management treatments resulted in lower dry weights of weeds compared to the untreated weedy control. Weed weights in plots treated with metribuzin were significantly higher than those in other management treatments but lower than in weedy plots. All management treatments, except metribuzin, resulted in higher yields than in unweeded. Hand weeded tomatoes had the highest yield which was significantly greater than yield from tomatoes in the metribuzin, organic mulch and unweeded treatments but similar to black plastic mulch and glyphosate. Major weeds were *Amaranthus retroflexus, Solanum nigrum, Portulaca oleracae, Chenopodium album, Cyperus esculentus,* grasses and *Convolvulus arvensis.* The best control of these weeds was with glyphosate and the mulches (organic and black plastic), however, only glyphosate controlled C. *esculentus and metribuzin* was weak on *S.nigrum* and grasses.

INTRODUCTION

Tomato, *Lycopersicon esculentum* Mill., is one of the most important vegetable crops in Afghanistan. The 2014 ADCUS (Afghan Data Collection and Utilization Program) Horticulture Survey conducted by the Ministry of Agriculture, Irrigation and Livestock (Altai, 2014) indicated that 25% of all Afghan farmers produce tomatoes with 42-57% of farmers in warmer southern provinces growing tomatoes. Nearly half (48%) of tomato growers produce for home consumption while 48% sell about 50% of their production and 99% indicated tomatoes were important to very important to household welfare both for household diets and as an important cash crop. The average tomato production area was 0.1 hectare per farm with average yield being 17,850 kg*ha-1 and the crop returns 13 AFAs*kg-1 ($0.22*kg-1). Weed competition can be a limiting factor in production of most vegetable crops and especially in tomato as Ghoshe *et al.* (2010) found that tomato yield losses can be as high as 35% when weeds are not properly controlled. Since most weed management is by expensive hand removal, any technique to improve efficiency of weed management could be a valuable income improvement strategy. Approximately 70% of the Afghanistan population is involved in agriculture and in the past there was a reliable and inexpensive labor supply available so hand-weeding crops was usually the management method of choice (Ghafoori, 2017). Since most tomatoes are now grown in small gardens, hand weeding by family members is usually the technique employed. However, as the Afghanistan economy grows and tomato production area increases, reduced availability of inexpensive manual labor will occur and it will become necessary to adopt alternative, effective and less labor intensive weed control methods (Ahmadi, 2016). Some common weeds that occur and must be controlled in tomato production in Herat Province include redroot pigweed (*Amaranthus retroflexus* L.), black nightshade (*Solanum nigrum* L.), *common* purslane (*Portulaca oleracae* L.), common lambsquarters, (*Chenopodium album* L.), field bindweed (*Convolvulus arvensis L.), annual grasses* and yellow nutsedge (*Cyperus esculenthus* L.). Except for yellow nutsedge and field bindweed, the other weeds are annuals and propagate from seed, especially redroot pigweed, black nightshade, common lambs quarters, common purslane and annual grasses. However, common purslane can also spread vegetatively after cutting/hoeing which necessitates complete removal of all vegetative parts from a field after weeding (Saidak, 1981). Yellow nutsedge belongs to the family Cyperaceae and is a difficult to control perennial weed that reproduces by starchy nutlets (tubers) and field bindweed can spread from its extensive spreading root system. Organic mulches are a viable option for providing weed suppression by covering the soil and preventing light from impinging on the soil thus reducing germination of many weed seeds. When

Corresponding author: **Obaidullah GHAFORY,**
Department of Agronomy, Herat University, Herat, Afghanistan.

weeds germinate, the mulch can inhibit maximum growth (Bakht and Ahmad Khan, 2014). Wheat is a common grain crop in Afghanistan and since wheat straw biomass is readily available it is a common organic mulch that most farmers can use. Another mulch option is black plastic mulch, if available, that is a common method used in developed countries to manage weeds and assist in water management in vegetable crops (Bakht and Ahmad Khan, 2014). Glyphosate is an herbicide option that could be used in tomato culture as a spot treatment applied to emerged weeds and applied to avoid contact with the crop. Glyphosate is a systemic broad spectrum foliar applied herbicide used after emergence of weeds and is the most widely used herbicide in the world (Masabni, 2007). Glyphosate controls both annual and perennial weeds and is commonly used in fruit orchards, vineyards, sugarcane fields, in GMO agronomic crops, in cultivated lands after harvesting and as a directed spot treatment in many crops (Stoddard, 2012). It is absorbed by vegetative parts of the plant and is translocated to hypogeal organs (root, rhizome and tuber) within the plant and is effective against most annual and perennial weeds... Metribuzin is a common herbicide used throughout the world in tomato production as both a soil preemergent after first plowing and prior to tomato transplanting or post emergent application and is effective for control of many annual broadleaf weeds (Robinson *et al.,* 2006). This study was designed to 1) compare the efficacy of weed control in tomato using hand weeding, plastic and organic mulches, and two herbicides, glyphosate and metribuzin and 2) determine treatment effect on tomato yield.

MATERIALS AND METHODS

The experiment was established in the summer of 2014 at the Faculty of Agriculture Research Farm at Herat University, Afghanistan. The experiment field soil properties is shown in the following table:

was designed as a randomized complete block with four replications. Each experimental unit had two 3 m long rows of tomatoes spaced 0.4 m between plants within a row for a total of 21 plants per experimental unit and rows 70 cm apart between rows. There was 40 cm spacing between replications and 40 cm between experimental units within a replication. Treatments included:

1. **Hand weeded:** All weeds were removed weekly throughout the experiment duration.
2. Weedy: Weeds were uncontrolled during the experiment.
3. **Black plastic mulch:** Mulch, 75 cm wide and 30µ thick, laid prior to planting and holes punched in the plastic for planting of tomatoes.
4. **Organic mulch:** Twenty kg of rice straw was placed on the ground to a depth of about 10 cm around the tomato plants in each plot shortly after planting so no or minimal soil was exposed.
5. **Glyphosate:** applied weekly throughout the growing season as a 20% solution to any emerged weeds by wetting the leaf surface with a rope wick with no application to tomato plants.
6. **Metribuzin:** applied at 700 g*ha-1 in 300 L of water*ha-1 as a preplant application and lightly incorporated with a disk.

Variables measured

A count of the above ground total dry weight of all weeds in plots on 25 August 2014 at the completion of harvest, and tomato yields in kg*ha-1 over the course of the season. All fully ripe tomatoes were harvested twice weekly from 5 August 2014 until the experiment was completed on 25 August 2014. MSTAT-C software was used for analysis of variance and means were separated using Duncan's multiple range test.

Table 1. Soil properties of the experiment field before cultivation (depth 300 cm)

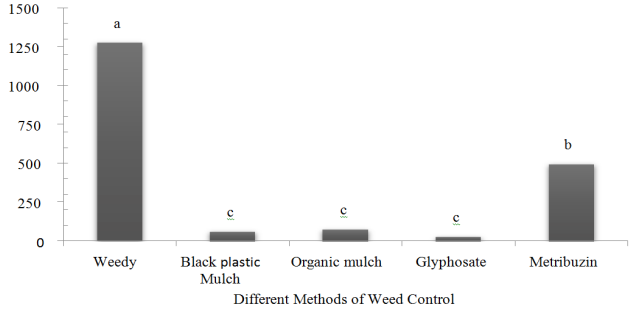
Soil Texture	BD (dsm^{-1})	pH	ECe (dsm^{-1})	SAR	N	P	K	OC (%)
					(%)	($mgkg^{-1}$)		
Sandy Loam	1.45	7.9	2.8	4.6	0.11	11.5	357	2.14

Source: (Soil laboratory of Agriculture faculty of Herat University, 2014)

Soil was amended with 50 kg N*ha-1 (urea), 100 kg P*ha-1 (P2O5), 50 kg K*ha-1 (K2O) plus 20 metric tons of cattle manure prior to soil preparation. An additional 50 kg N*ha-1 was applied twice during the growing season, at flower initiation and at fruit formation. The soil was prepared by moldboard plowing, followed by hand cultivation with shovels, hoes, and rakes to smooth the seedbed prior to planting. All plots were irrigated with drip irrigation, with between 0.7 and 1.4 liters of water*m-2 applied as needed every 3-6 days throughout the experiment. Seeds of tomato variety "Person" treated with captan (2 g*kg-1 seeds) for control of Pythium spp. and other soil pathogens were planted in 70 count trays on 26 February 2014 and grown in the greenhouse (18-20° C during the day, 14-16 ° C at night) until they reached approximately 15 cm in height, then moved outside the greenhouse for seven days to harden plants prior to transplanting to the field on 21 April 2014. Person" is a cultivar well adapted to the Herat Province climate, has good eating and storage qualities, is popular in the marketplace and has disease resistance to early and late blight. The experiment

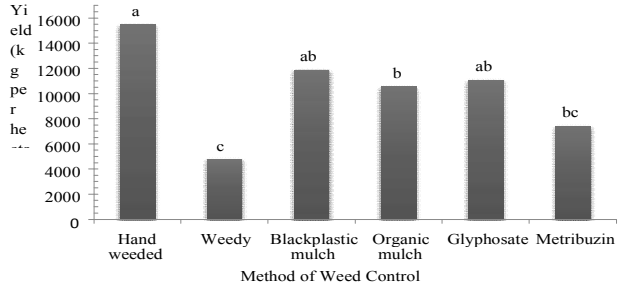
RESULTS AND DISCUSSION

Results show that the various weed management treatments differed in total dry weights of weeds observed. The greatest weed biomass was in the weedy control followed by the metribuzin, while the two mulch and glyphosate treatments had the lowest weed biomass (Fig. 1). Metribuzin does not control grasses well so most of the dry weight of weeds in the metribuzin treatment was for grassy weeds and for black nightshade. Even though there were more weeds present in metribuzin treated plots compared to the other weed management treatments, all these treatments had fewer weeds than the weedy control plots. The mean tomato yields from each of the weed management treatments showed that the hand-weeded plots had the highest yields, although, they were statistically similar to the yields from tomatoes grown in black plastic mulch or tomatoes grown in plots treated with the glyphosate (Fig. 2). In terms of yield for the herbicide treated plots and the mulched plots, all tomatoes grown in these treatments had similar yields and all treatments whether hand



Means followed by the same letters are not significantly different (Duncan Multiple Range Test, P > 0.05)

Fig. 1. Mean dry weights of weeds from tomato weed management trial conducted at Herat University, 2014



Means followed by the same letters are not significantly different (Duncan Multiple Range Test, P>0.05)

Fig. 2. Mean weights of tomatoes harvested from tomato weed management trial conducted at Herat University, 2014

weeded, herbicide treated or mulched had greater yields that the unweeded plots. These data show that as shown in previous studies with weed control by use of herbicides, mechanical and mulches that weeds do reduce tomato yields when left uncontrolled.

Conclusion

The standard weed management practice in Herat Province in Afghanistan is hand removal of the weeds and this practice is viable as long as field sizes are small and inexpensive manual labor is readily available. If those conditions change, farmers may need to adopt a less labor intensive weed management strategy. Our results show that a pre-plant incorporated application of metribuzin applied alone, is not, as a stand-alone herbicide treatment, a viable strategy to reduce or eliminate all weeds. Metribuzin did a good job of controlling most broadleaf weeds present in this experiment but grassy weeds became a major problem. In the future, metribuzin should be applied with an herbicide that controls most annual grasses and this would be a more logical approach for acceptable weed management and good tomato yields. Our results showed that weed populations present in the metribuzin treated plots were at higher levels and tomato yields were lower than in the hand weeded plots, although, yields were not less than in the other weed management treatments. Although the organic mulch treatment provided excellent weed control, yields in those plots were suppressed to a level lower than the hand weeded plots. Further research would be needed to determine if this was the result of nutritional and/or moisture issues because of the mulch. The black plastic mulch and glyphosate plots both provided excellent weed control and tomato yields that were similar to the tomatoes grown in the hand weeded plots. Black plastic mulch is somewhat expensive which may be an economic barrier to adoption of this technology. Glyphosate, while an additional input cost, is relatively inexpensive to use when applied directly to weeds with a rope wick and should be seriously considered for adoption as a weed management practice in Herat Province. It is clear from this research that the use of glyphosate is a relatively inexpensive method to effectively control all weeds encountered during this study. Metribuzin provided excellent control of broadleaf weeds, but, as expected, was not effective against grasses or nutsedge. Therefore, metribuzin should only be used in combination with another herbicide or other practices that control those weeds. Considering the constraints on Afghan agriculture resulting from lack of water, the use of either plastic mulch or organic mulch in combination with trickle irrigation will reduce the amount of water used in irrigation as well as conserve the water in the soil. Yields in the organic mulch plots were somewhat suppressed but the losses would need to be weighed against the increased costs of the plastic mulch. Neither mulch effectively controlled nutsedge, so adoption of either of these strategies would require use of some other technique for nutsedge control. Improved weed management is an important income management strategy for Afghan tomato growers. In rural areas where production is more for home use and households have excess labor, hand weeding is an appropriate strategy. In more urban areas and on farms focusing on commercial production, proper utilization of glyphosate can be an effective strategy for managing weeds in tomatoes. Development of Extension training materials on effect weed control for home and commercial tomato production using hand weeding and chemical application strategies would be appropriate methods to share these research results and to teach growers how to allocate time and other resources to maximize production and income.

REFERENCES

Ahmadi, Mohammad Shoaib, 2016. Principle of weeds controlling and recognition, Kabul: University publications, second edition. pp. 60-67

Altai, 2014. The 2014 ADCUS Horticulture Survey conducted by the Ministry of Agriculture, Irrigation and Livestock

Bakht, Taman and Ahmad Khan, Ijaz, 2014. Weed control in Tomato (*Lycopersiconesculentum* Mill.) through mulching and herbicides. Pak. J. Bot., 46(1): 289 – 292

Ghafoori, Obaidullah, 2017. Weed Identification and Control, Herat University: Setare – e – Noqraei Publications, Second edition. pp. 60-67.

Ghosheh, Hani., Al-Kawamleh, Mohammad., Makhadmeh, Ibrahim, 2010. Weed competitiveness and herbidal sensitivity of grafted tomatoes (*SolanumLycopersicon* Mill.), Journal of Plant Protection Research, Vol. 50, No. 3: (307 – 313).

Masabni, Joe, 2007. Herbicide Recommendations for Tomato, Princeton, Ky, pp 5-17.

Robinson, Darren E., Soltani, Nader., Hamill, Allan S., Sikkemma, Peter H. 2006. Weed control in processing tomato (*Lycopersiconesculentum*) with Rimsulfuron and Thifensulfuron on applied alone or with Chlorothalonil or copper pesticides, HortScience 41(5): 1295-1297.

Saidak, W. J. 1981. Chemical weed control in transplanted tomatoes, Canadian Journal of Plant Science, Vol. 42: (190 – 196).

Stoddard, C. Scott, 2012. Weed control in tomatoes and other warm season vegetable crops, University of California Cooperative Extension, pp (1-2).

****