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Report

Evaluation of Herbicides Efficacy against Weeds in Coffee (*Coffea arabica* L.) at Jimma Southwest, Ethiopia

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Abstract

Weeds are one of the most serious causes of economic losses in agricultural production. As a result weed completions contributes 60 to 80% yield losses in coffee under Jimma condition. Currently, expensiveness of weed management has been a principle issue in economic analysis of coffee production particularly in large scale farm in Ethiopia. Hence, evaluation of systemic herbicide with different mode of action is essential to effectively control dangerous weeds in coffee production system. The study was conducted in Jimma Agricultural Research Center in 2021 cropping season at Jimma Agricultural Research Center on Station to evaluate the efficacy of newly introduced herbicides (Fascinate 280SL at 3.3l/h, Jimila 480% SL at 3.0l/h and Proper 360 SL at 3.0l/ha) against major weeds in coffee. Tested herbicides (Fascinate 280SL, Jimila 480% SL and Proper 360 SL) were effectively controlled the noxious weeds infested coffee experimental plots. These herbicides also showed significant effect on inhibiting weed density over standard check. The herbicide were effective in controlling weeds in coffee safe for crops if applied at active growth stage of weeds following the instructions on technical guide line of herbicides properly. Therefore, the herbicides were recommended used as management option against weeds in coffee with the application rate mentioned above

Keywords

Herbicides, Efficacy, Fascinate 280SL, Jimila 480% SL, Proper 360 SL, Weed Density, Jimma

1. Introduction

Ethiopia is considered a powerhouse and largest coffee producer in Africa. While over six million farm households are involved in coffee production [1], more than 15 million people rely on the sector for their livelihoods [2]. The country is the center of origin and genetic diversity of Arabica coffee which is 70% of the total coffee traded in the world [3, 4]. It is estimated that smallholder farmers contribute above 90% of Ethiopian coffee that is organically produced [5]. The smallholder coffee producer in the country is characterized by being rain-fed, low input-having low levels of investment (limited use of pesticides and fertilizers) which is consequently, low output obtaining 0.64 tons per hectare average yield [6].

Among thus factors affecting coffee production, weeds are one of the most serious causes of economic losses in agricultural production [7]. They compete with crops for space, nutrients, water and light [8]. As a result weed contributes 60 to 80% yield losses in coffee under Jimma condition [9]. They also directly influence on the affairs of humans more than any other pest in developing countries, like Ethiopia. The weed

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flora of Ethiopia is highly diverse and it is composed of a wide range of perennial and annual grasses and broad-leaved weeds, sedges, parasitic and invasive weed species [10].

The high rainfall and hot humid climate in the coffee-producing country encourage the rapid and continuous growth of the noxious weeds. In this situation, it is essential to apply systemic herbicides to control the perennial sedges and grass weeds that are above ground as well as the deeply ingrained rhizomes, bulbs, and tubers. Nowadays, the major concern in coffee production, especially in Ethiopian large-scale farms, is the cost of weed control [11]. This is because of the weed species those are found as dominant and prevalent in the areas where they favorably and quickly re-appear within the season. Hence, evaluation of systemic herbicide with different mode of action is essential to effectively control dangerous weeds in coffee production system. Herbicide-based weed management methods have the advantage of requiring less time and labor, and they can prevent the spread of diseases that can arise from manual slashing and hoeing weeds beyond providing effective & efficient weed control [12].

Having above mentioned points this herbicide verification trial will be conducted following Guidelines for Pesticide Testing (Version 5) developed by Ethiopian Institute of Agricultural Research [13] to evaluate the efficacy of newly introduced herbicides against major weeds in coffee compared with already registered and commonly used herbicide Round up 360 SL herbicide at Jimma Southwest Ethiopia. Therefore, study was to evaluate the efficacy of newly introduced the herbicides to against coffee weeds.

2. Materials and Methods

2.1. Descriptions of the Study Area

The study was conducted in Jimma Agricultural Research Center in 2021 cropping season. JARC is found in Oromia regional state in Jimma zone, Ethiopia, 360 km to southwest of Addis Ababa. It is located at 07°46''N latitude and 36 °47'E longitude with an elevation of 1753 m.asl receiving average annual rainfall of 1572mm. The area experience has mean daily minimum and maximum temperature of 11.6 ℃ and 26.3 ℃, respectively. The major soil type of the center is chromic nitosol and cambiosl of upland and fluvisoil of bottom land.

2.2. Study Design and Methods

The study was laid out on already established coffee experimental plots with a naturally infested field where the noxious perennial grasses, perennial broad leaf weeds perennial sedges and annual broad leaf weeds were abundantly growing.

The study consists consist five (5) as treatments evaluated with single plot experimental design on 10 m x 20m plot size (Table 1). The weed data such as: weed species type, flora composition within desire experimental plots and weed density were recorded before spraying herbicides using 50 cm x 50cm quadrate. The herbicides sprayed one time with in the season at actively growing stage the weeds. The experimental plots closely monitored and evaluated for various herbicide efficacy test parameters by fifteen days intervals till about 60 days after herbicide application.

Table 1. *Treatment Description.*

Trade Name	Common Name	Active Ingredients	Application Time	Application Rate (L/ha
Fascinate 280SL	Glufosinate Ammonium	280g/L glufosinate ammonium)		3.3 L/ha
Jimila 480% SL	Glyphosate	480 g/L Glyphosate isopropylamine salt	At actively growing stage of major coffee weeds	3 L/ha
Proper 360 SL	Glyphosate	360g/l Glyphosate (glycine)		3 L/ha
Roundup 360 SL	Glyphosate	Glyphosate 36%g/l		3 L/ha
Weedy control				

3. Results and Discussion

3.1. Weed Infestation

Different weed species belonging to the annual broad leaf, grasses and sedges and perennial broad leaf, sedge, and grass categories were identified. Accordingly Twenty-one (21) weed species belonging to twelve (12) families were recorded within the experimental field. Among the recorded species 9.52% sedge, 19.05% grass and 71.43% were broad leaved weed species, respectively. This result is consistent with [14] conclusion that these are the major weed species that are prevalent growing (infected) in coffee crops. Similarly, in terms of their life cycles 47.62% perennial, 47.62% annual and 4.76% were biennial weed recorded from the experimental fields (Table 2). As study result showed number of perennial grasses is greater than annual grasses whereas annual broad leaved were more prevalent than perennial and biennial broadleaved in the sites.

Table 2. *Taxonomy of weed species recorded in the study plot.*

Scientific Name	Family	Common Name	Life cycle	Morphology
Cyperus cyperiodes	Poaceae	Small flower ubrelasedg	Perennial	sedge
Cyperus rotundus		Purple nutsedge	Perennial	sedge
Digitarai abyssinica		African coach grass	Perennial	Grass
Echinocloa colona		Jungle rice	Perennial	Grass
Paspalum comjugatum		Bufallo grass	Perennial	Grass
Cynodon dactylon		Star grass	Perennial	Grass
Hydrocotyle Americana	Apiaceae	Indian pennywort	Perennial	Broadleaf
Commelina benghalensis	Commelinaceae	Tropical spiderwort	perennial	Broad leaf
Ageratum conyzoides	Asteraceae	Goat weed	Annual	Broad leaf
Bidens pilosa		Black jack	Annual	Broad leaf
Galinsoga parviflora		Gallant soldier/ potato weed	Annual	Broad leaf
Conyza albida		Asthma weed	Annual	Broad leaf
Alternantherra caracasana	Amarathaceae	Paper thorn	Perennial	Broad leaf
Capsella bursa-pastoris	Brassicaceae	shepherd's purse	Annual	Broad leaf
Brassica tournefortii		African mustard	Annual	Broad leaf
Plantago lanciolata	Plantagnaceae	Narrow leaf plantain	Annual	Broad leaf
Portulaca oleracea	Portulacaceae	duckweed	Annual	Broad lead
Cynoglossum lanceolatum	Boraginaceae	Hounds tongue	Biennial	Broad leaf
Galium aparinae	Rubiaceae	Cleavers/bedstraw/ catch weed	Annual	Broad leaf
Polygonum arvensis	Polygonaceae	knotweed and knotgrass	Perennial	Broad leaf
Trifolium repens	fabaceae	Clover /trefoil	Annual	Broad leaf

3.2. Herbicide Effect on Weed DENSITY

All tested herbicides were effectively affected weed species density over standard check at 30 days after herbicides application at (figure 1). The result showed that the evaluated herbicides have effectively controlled the perennial grasses, sedges, broad leaf and annual broad leaf weeds infested coffee experimental field.

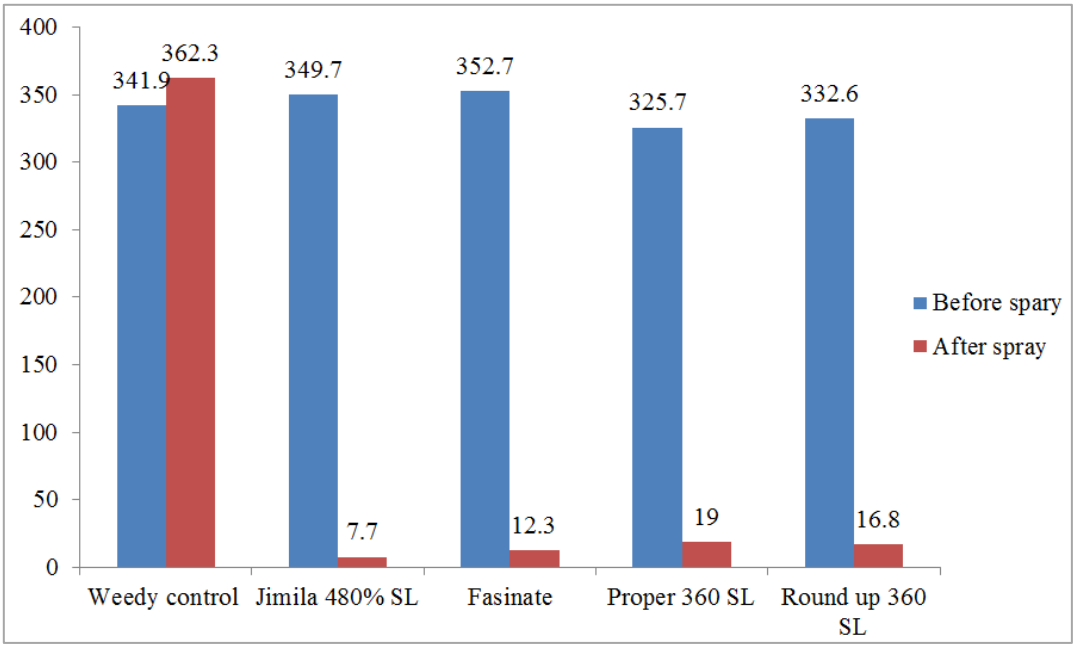

Figure 1. *Effect of Herbicide on Weed Population at 30 days after Application.*

3.3. Effect of Herbicides on Individual Weed Species

Tested herbicides gave complete control of the perennial grass, broad leaf, perennial sedges and the annual broad leaf weeds in 28 days after herbicide application.

Herbicides (Fascinate, Jimila and Proper) were started showed weed growth retardation, foliar cholrosis, wilting and stand reduction symptoms on all weed species found in the experimental plots within 6-7 days, 7 days and between 5-7 days respectively after herbicides application. This result in lines with who reported herbicides with different herbicides provide good control of perennial grasses, perennial broad leaf weeds and perennial sedge, biennial broad leaf and the annual broad leaf weeds within different rage of time based on herbicide nature and mode of actions [11]. Additionally tested herbicides gave good control of noxious, highly competitive weeds for all growth requirements the perennial grasses, perennial sedges and some perennial broad leaf between 21-28 days after application. These include *Cyperus species Commelina benghalensis Hydrocotyle american*, *Cynodon* species, *Digitaria* Abyssinica and *Echinocloa colunum.*

3.4. Weed Flora Shift

A weed shift is the change in the composition or relative frequencies of weeds in a weed population (all individuals of a single species in a defined area) or community (all plant populations in a defined area) in response to natural or human-made environmental changes in an agricultural system. This occurred at the end of the season after weed management practices done. Weed species shift was evaluated 60 days after herbicide application. The result showed that tested herbicides were changed weed flora composition of the experimental field similar with standard check herbicide. The weed species changed to annual broad leaf weeds after controlling the dense cover of perennial grasses, perennial broad leaf, perennial sedges and the annual broad leaf weeds at both locations.

4. Conclusion and Recommendation

In generally, present efficacy test trial showed that tested herbicides (Fascinate 280SL, Jimila 480% SL and Proper 360 SL) were effectively control perennial grasses, perennial sedges and the perennial broad leaf weeds and annual broad leaf weeds of coffee in the location. These herbicides also showed significant effect in inhibiting weed density over standard check (Round up 360) if used properly. Therefore newly introduced tested herbicides fascinate at 3.3 L/ha, Jimila 480% SL at 3 L/ha and Proper 360 SL at 3 L/ha with 200 liters of water per hectare were be recommended used as weed management option against weeds in coffee.

Abbreviations

g/L	Gram per Liter
JARC	Jimma Agricultural Research Center
L/ha	Liter per Hector
SL	Soluble Liquid

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Author Contributions

Tigist Bidira is the sole author. The author read and approved the final manuscript.

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Conflicts of Interest

The author declares no conflicts of interest.

References

[1] CSA. (2020). Report on area and production of major crops. (Private peasant holdings, meher season), Central Statistical Agency; agricultural sample survey 2019/20). The Federal Democratic Republic of Ethiopia: Addis Ababa, April 2020. http://www.statsethiopia.gov.et/wp-content/uploads/2021/05/2013-MEHER-REPORT.FINAL_.pdf

[2] USDA/United States Department of Agriculture (2018). Coffee: World Markets and Trade. Foreign Agricultural Service. GAIN Report Number: ET1820, May 2018. https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfile-name?filename=Coffee%20Annual_Addis%20Ababa_Ethiopia_5-24-2018.pdf

[3] ECFF (Environment and Coffee Forest Forum). (2015). Coffee: Ethiopia's Gift to the world.

[4] KRBG (Kew Royal Botanic Gardens) and ECFF (Environment & Coffee Forest Forum) (2017). Coffee farming and climate change in Ethiopia. https://www.kew.org/sites/default/files/2019-01/Coffee%20Farming%20and%20Climate%20Change%20in%20Ethiopia.pdf

[5] EtBuna. (2021). Connecting Ethiopian Coffee to Sustainable Market. https://etbuna.com/ethiopian-coffee/coffee-production-system-in-Ethiopia/

[6] Tadesse T, Tesfaye B and Abera G. 2020. Coffee production constraints and opportunities at major growing district of Southern Ethiopia. *Cogent Food & Agriculture*; 6(1): https://doi.org/10.1080/23311932.2020.1741982

[7] Kuang, W., Wang, C., Mao, W. (2016). Screening and evaluation of herbicidal metabolites produced by Trichoderma spp. Afr. J. Microbiol. Res. 10(24), 866-872. https://doi.org/10.5897/ AJMR2015.7867

[8] Wu, J., Ma, J. J., Liu, B., Huang, L., Sang, X. Q., Zhou, L. J., (2017). Herbicidal spectrum, absorption and transportation and physiological effect on *Bidens pilosa* of the natural alkaloid berberine. J. Agric. Food Chem. 65(30), 6100–6113. https://doi. org/10.1021/acs.jafc.7b012

[9] Tadesse E, (1998). Weed control in the western coffee growing areas of Ethiopia. pp: 22-27. *In:* Beyene S and Abera D. (eds) 1998. Agricultural research and technology Transfer Attempts and Achievements in Western Ethiopia. Proceedings of the third Technology Generation, Transfer and Gap Analysis Workshop. 12-14 November 1996. Nekemt, Ethiopia.

[10] Fasil, R., (2006). Weed Management Research Experience in Ethiopia. Proceedings of Planning Workshop on "Facilitating the Implementation and Adoption of Integrated Pest Management (IPM) in Ethiopia, No. 17.

[11] Tigist Bidira, Tamiru Shimales. (2023). Evaluating Herbicides Efficacy Against Coffee Weeds in Southwest Ethiopia. Modern Chemistry, 11(4), 70-77. https://doi.org/10.11648/j.mc.20231104.11

[12] Chikoye D, Udensi UE and Lum AF (2005) Evaluation of a new formulation of atrazine and metolachlor mixture for weed control in maize in Nigeria. Crop Protection 2(11) 1016-1020.

[13] EIAR (Ethiopian Institute of Agricultural Research) (2023). Pesticide Testing Guide line. website: http://www.eiar.gov.et

[14] Surinder SR. (2016). Weed indices. Available. https://www.researchgate.net/publication/320268615_34.Weed_indices (Accessed)

Biography

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