East African Scholars Journal of Agriculture and Life Sciences
Abbreviated Key Title: East African Scholars J Agri Life Sci
ISSN 2617-4472 (Print) | ISSN 2617-7277 (Online)
Published By East African Scholars Publisher, Kenya
Volume-7 | Issue-2 | Feb-2024 | DOI:10.36349/easjals.2024.v07i02.001

OPEN ACCESS

Original Research Article

Effect of Chemical and Hand weeding Control Methods on Growth Yield Components and Yield of Field Pea in Bale Highlands, Southeastern Ethiopia

Tamiru Meleta[1*], Reta Dargei[2], Dagne Kora[3], Baharu Dajane[4]
[1,2,3,4]Oromia Agricultural Research Institute, Sinana Agricultural Research Centre, Bale-Robe, Ethiopia

Article History
Received: 26.12.2024
Accepted: 31.01.2024
Published: 07.02.2024

Journal homepage:
http://www.easpublisher.com

Quick Response Code

Abstract: Afield experiment was conducted during bona season of 2019/2020 and 2021/2022 at two location Agarfa sub-site and Sinana on station to evaluate the integrated effects of pre-emergence herbicides and hand-weeding on weed control, yield components, yield, and their economic feasibility for cost effective weed control in field pea. The treatments consisted of three dual gold rates (1, 2 and 3 liter per hectares) and three times (0, 1and 2 times hand weeding). The experiment was laid out in a factorial arrangement of RBCD with three replications. Results indicated that Dual-gold 2 liter per hectare supplemented with hand weeding at 25-30 days after crop emergence resulted in the highest grain yield and economic benefit. However, in case labor is constraint and Pre-emergence herbicide is timely available, pre emergence application of Dual-gold 2 liter per hectare should be the alternative to prevent the yield loss and to ensure maximum net benefit for the producers. Thus, the result of this study, it can be tentatively concluded that herbicides application is an integral part of farmer's pulse crop management in modern agricultural systems.

Keywords: Chemical, Hand weeding, Field pea weed management.

Copyright © 2024 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution **4.0 International License (CC BY-NC 4.0)** which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

INTRODUCTION

Pulses are the cheapest and important source of dietary protein for humans. Field pea (*Pisum sativum* L.) is an important food legume, which is widely cultivated in tropic, sub-tropic and temperate regions of the world. It also plays a vital role in improving soil health, by adding huge amounts of organic matter and fixing of biological nitrogen. It leaves about 30 kg N ha^{-1} into the soil which is useful for succeeding crop (Anonymous, 2006). Weeds are the major threats in field pea which limits the productivity (Tripathi *et al.*, 2011). Weeds Present in the field pea, due to its initial slow growth and short stature, results in huge yield loss (Chaudhary *et al*., 2009). Weed competition resulted in the yield reduction of up to 65.8% (Mishra, 2006; Veres and Tyr, 2012). For the control of weeds, generally farmers adopted manual weeding (Singh and Wright, 2006). But due to increased labour cost and scarcity of labour, manual weeding become a difficult task in field pea, which force them for alternative, cheaper and easier method of chemical weed control. Hand weeding or hoeing which is very effective but it is not only laborious and insufficient but also expensive *i.e.* most of times due to continuous rains, scarcity of labours during peak period and financial limitations, it make weeding difficult after the initiation of reproductive stages of growth. Thus, there is need to develop efficient and economically viable system for managing weeds. So, herbicides are the only alternatives left under such circumstances of unavailability of labours, high cost of labours and unfavorable environment. Pre-emergence application of herbicides proved effective in reducing density and dry matter production of weeds resulted in higher yield attributes and seed yield of field pea (Govardhan *et al*., 2007). Weeds are generally controlled with the conventional methods i.e. cultural manipulation either by Chemical weed control which is easier, time saving and economical as compared to hand weeding alone. Presently a wide variety of old and new generation herbicides are available and being recommended for usage. Efficacy of Dual gold herbicides combined with hand weeding has not yet been evaluated in Field pea growing in mid and highlands of south eastern Ethiopia. Therefore, the objectives of this study was to evaluate the effect of pre-emergence herbicides with or without hand weeding on weed control, yield components and yield of field pea and to assess the economic feasibility of supplementing herbicides with hand weeding for effective and cost effective weed management.

***Corresponding Author:** Tamiru Meleta
Oromia Agricultural Research Institute, Sinana Agricultural Research Centre, Bale-Robe, Ethiopia

MATERIALS AND METHODS

Description of Experimental Site

The experiment was conducted on research field of Sinana Agricultural research center and Agarfa sub-site, Highlands of Bale, Southeastern Ethiopia under rain fed conditions during 2020 and 2021 main cropping season. Sinana is located at a distance of about 463 km from Addis Ababa at about 7^0 07' North longitude and $40^0$10' East latitude, at an altitude of about 2400 meters above sea level. On other hand, Agarfa is located at a distance of about 460 km from Addis Ababa situated at $38^0$40' to 46^0 3' East latitude and 40^0 to $80^0$11' North longitude, at an altitude of about 2350 meters above sea level. The areas are characterized by bimodal rainfall pattern which is locally named Bona and Ganna season named based on the time of crop harvest. Soils are characterized as Cambisol and Vertisol at Sinana and Agarfa respectively.

Treatments and experimental design

The treatments were comprised of nine different weed management practices *viz*., pre-emergence application of Dual gold 1 lit on 2 DAS or followed by 2 and 3 lit/ha applied in sequence with or without hand weeding on 21 DAS. The treatments were arranged in randomized complete block design with three replications.

Experimental procedure and management

All field activities were done with standard production practices. The land was cultivated by oxen plough (Farmers practice) and pulverized by hand and rows were made to plant seeds. Accordingly, the treatments included three dual-gold rates (1, 2 and 3 liter per hectare) and three weeding frequency (no weeding, one time and two times weeding) laid out in a randomized complete block design with three replications. The Field pea variety "Harana" was used as teste crop. The gross plot size was 4m × 1.2 m (4.8 m^2) with 20 and 10 cm inter and intra-row spacing, respectively. Spacing of 0.8 and 1.5 m were allocated between plots and blocks, respectively. The net harvestable area was 4m × 0.8m (3.2m^2) and harvesting was done manually at crop maturity.

Table 1: The Treatments

No.	Treatments
1	Dual-gold 1lit/ha
2	Dual-gold 2lit/ha
3	Dual-gold 3lit/ha
4	Dual-gold 1lit/ha+HW
5	Dual-gold 2lit/ha+HW
6	Dual-gold 3lit/ha+HW
7	one time HW
8	Two time HW
9	Weedy check

Data Collection

Weed density was taken twice (at the time of first and second hand weeding) for each individual weed species from each plot using 0.25m^2 quadrants four times. The weed species found within the sample quadrant were identified, counted and expressed in m^2. Individual and general weed control scores were also taken four weeks after herbicide application, first and second hand weeding and at the time of harvest. At harvest the weeds were cut near the soil surface and placed in an oven at 65^{o}c temperature till constant weight and their dry weight was measured. The dry weight was expressed in gm-2. The data on weed density and dry matter were subjected to $\sqrt{x+0.5}$ transformations before analysis.

$$\text{Weed control efficiency: } WCE = \frac{(WDC - WDT)}{WDC} \times 100$$

Where: WCE=Weed Control Efficiency, WDC= Weed Dry mater in weedy check, WDT=Weed Dry Matter in particular treatment

Plant height: Was measured from 5 randomly selected plants in each plot.

Thousand seeds Weight: Seeds were counted randomly and their weight was measured at 10 % grain moisture content.

Grain yield was also measured after threshing the sun dried plants harvested from each plot and adjusted at 10% grain moisture content.

Partial budget analysis was calculated by taking in to account the additional input cost (the labor cost for hand weeding, harvesting, threshing and winnowing) and gross returns obtained from different weed control treatments.

Statistical Analysis

Finally, all data were subjected to analysis of variance following a procedure appropriate to the design of the experiment using SAS statistical software, where ANOVA and mean separation were carried out at 5% level of probability.

RESULTS AND DISCUATION

Weed Control Efficiency

Weed control efficiency (%) was affected significantly by different rates of dual –gold herbicide. The maximum weed control efficiency was recorded in twice hand weeded plot (94.13%) followed by Dual-gold at 3 litter per hectare plus one hand weeding (90.28%). While, the lowest weed control efficiency was recorded in weedy check (0). The result is in agreement with the findings of (Jafari, R, *et al*., 2013) who reported that pre-emergent herbicides gave higher weed control efficiency by reducing the weed density and dry weight significantly as compared to weedy check.

Table 2: The major problematic weeds in the experimental fields during 2019/20 and 2020/21 cropping seasons

Botanical name	Family	Life form	Category
Galinsoga parviflora	Composite	Annual	Broad Leaved
Guzotia scabra	Composite	Annual	Broad Leaved
Raphanus raphanistrum	Brassicaceae	Annual	Broad Leaved
Oxalis latifolia	Oxalidaceae	Perennial	Broad Leaved
Plantago lanceolata L.	Plntaginaceae	Annual	Broad Leaved
Setaria pumlia	Poaceae	Annual	Grass Leaved
Snowdenia polystachya,	Poaceae	Annual	Grass Leaved
Phalaris paradoxa	Poaceae	Annual	Grass Leaved
Avena fatua	Poaceae	Annual	Grass Leaved
Polygonum nepalensis	Polygonaceae	Annual	Broad Leaved
Brumuspectinatus Poaceae	Poaceae	Annual	Grass Leaved
Gallium spurium	Cleavereae	Annual	Broad Leaved
CommelinasublataL.	Commelinaeae	Annual	Broad Leaved
Cyperusassimilis L.	Cyperaceae	perennial	Sedge Leaved
Chenopodium album L	Chenopodium album	Annual	Broad Leaved
Amaranthus hybridus L.	Amaranthaceae	Annual	Broad Leaved

Table 3: Effect of different weed management practices on weed density, weed dry weight, weed control efficiency, of field pea at Sinana and Agarfa

Treatments	Weed density (Nos.m^{-2}) 45 DAS	Weed dry weight(gm^{-2}) 45 DAS	Weed control efficiency (%)
Dual-gold 1lit/ha	141.2^{c}	24.5^{c}	55.05^{d}
Dual-gold 2lit/ha	135.9^{c}	23.1^{c}	57.61^{d}
Dual-gold 3lit/ha	104.1^{d}	15.4^{d}	71.74^{c}
Dual-gold 1lit/ha+HW	143.6^{c}	24.9^{c}	54.31^{d}
Dual-gold 2lit/ha+HW	36.3^{e}	6.8^{e}	87.52^{b}
Dual-gold 3lit/ha+HW	31.4^{e}	5.3^{f}	90.28^{a}
One time HW	205.6^{b}	31.76^{b}	41.72^{e}
Two time HW	24.3^{ef}	4.2^{f}	92.29^{a}
Weedy check	354.8^{a}	54.5^{a}	0.00
LSD	8.1	1.40	4.61
CV(%)	17.4	4.2	5.33

Mean value within column followed by same latter(s) are not significantly different at 5%; LSD= least significant difference P<0.05: DAS=(Days After Sowing),HW= (Hand weeding)

Crop phenology and growth

Days to 50% flowering and 90% physiological maturity

Both days to 50% flowering and 90% physiological maturity were significantly influenced by weed management practices. Field pea plants attained early average flowering date of 65 days. In weedy check, the shading of crop plants by weeds might have reduced sunlight interception thus prolonged the vegetative growth resulting in delayed days to flowering (Table 4). In line with this result, Sunday and Udensi (2013) identified that the plants in not weeded plots took the longest time to reach 50% flowering in cowpea. The influence of weed management practices on 90% days to physiological maturity was followed similar trend to 50% days to flowering at both sites.

Plant Height

The maximum plant height (149.3 cm) was recorded from weedy check which did not significantly vary with plots treated with Dual-gold 2 lit/ha. The two time hand weeding plot had lowest plant height (125.5 cm) that was due to the impact of weeds on the growth and development of field pea. The height in weed free treatment might be due to abundance of growth promoting factors in both treatments that allowed the plants to attain their maximum height. The increased plant height with the weedy plot might be due to the effect of severe competition among plants which make them elongated in search of light and lack of availability of plentiful of growth encouraging factors in weedy plot that allowed the plants to increase in height. The competition between weeds and crop for sun light and space in weedy plots resulted in tall height of plants. Similarly, Salahuddin *et al.*, (2016) reported that the competition among weeds and wheat plant enforced to grew plant.

Table 4: Effect of weed management practices on Days to flowering, Days to Maturity, Plant height and Productive tiller plant of field pea

Treatments	Days to flowering	Days to Maturity	Plant Height(cm)	Productive tiller plant^{-1}
Dual-gold 1lit/ha	68.42^{bc}	127.00^{bcd}	134.78^{bcd}	2.88^{b}
Dual-gold 2lit/ha	68.25^{bc}	127.00^{bcd}	146.22^{ab}	3.38^{ab}
Dual-gold 3lit/ha	67.17^{bcd}	127.83^{b}	137.04^{abcd}	3.27^{ab}
Dual-gold 1lit/ha+HW	66.58^{bcd}	125.67d^{e}	135.75^{bcd}	3.63^{a}
Dual-gold 2lit/ha+HW	65.00^{e}	124.83^{e}	129.81^{cd}	3.58^{a}
Dual-gold 3lit/ha+HW	67.42^{bc}	125.83^{cde}	134.89^{bcd}	3.62^{a}
one time HW	68.83^{ab}	127.83^{b}	142.53^{abc}	3.48^{a}
Two time HW	65.42^{de}	127.42^{bc}	125.58^{d}	3.63^{a}
Weedy check	70.33^{a}	129.92^{a}	149.33a	2.89^{b}
Lsd (5%)	1.91	1.68	13.18	0.57
CV (%)	3.49	1.63	11.84	20.95

Mean value within column followed by same latter(s) are not significantly different at 5%; LSD= least significant difference P<0.05: HW= (Hand weeding)

Yield Components and Yield of field pea

Pod per plant and seed per pod

The analysis of variance showed that significant variation was observed on number of pod per plant. Whereas seed per pod showed non significant different among treatments (Table 5). The highest number of pods (13.86) plant^{-1} was recorded from dual-gold 2 liter per hectare plus one time hand weeding. Seed per pod was significantly increased under weed free environment (Munakamwe *et al*., 2008). Higher yield attributes under these treatments may be due to lesser crop-weed competition, which gave better environment for crop growth and development of crop. In these treatments weed population and their growth was abstracted during initial as well as latter stage of crop growth by sequential hand weeding. It confirms the conclusion drawn by (Chaudhary *et al*., 2009) from the results of their experiments on weed control in pulses.

Total above Ground Biomass

Above ground biomass yield ranged from 9204.51 kg ha-1 to 5529.38 kg ha-1(Table 5). The highest biomass yield (9204.51kgha^{-1}) was recorded for weed free treatment followed by two times hand weeding (8513.89 kgha^{-1}). Minimum biomass was recorded at weedy plots with the mean of 5529.38 kgha^{-1}(Table 5). This lowest biomass yield at weedy plot could be due to lower weed control efficiency. Among herbicide treated plots herbicide combination at lower rate had better biomass yield than herbicide combination at recommended rate and single application of recommended rate. Similarly, Hassan *et al*., (2003) reported that the mixture of herbicides produced a higher biomass yield than weedy check plots.

Table 5: Influence of d Weed Management Practices on Yield and Yield Components of field pea in Southeastern Ethiopia, Sinana and Agarfa 2020 and 2021

Treatments	Pod per plants	Seed per pods	Biomass yield kg/ha^{-1}	Grain Yield kg/ha^{-1}	Thousand Seed weight(gm)	Harvest index
Dual-gold 1lit/ha	10.23bcd	4.11	6751.74de	1816.60cd	167.67	26.74
Dual-gold 2lit/ha	11.66ab	4.61	6392.36def	1813.44cd	166.40	26.95
Dual-gold 3lit/ha	11.51abc	4.18	7362.99bcd	2002.15cd	172.33	27.11
Dual-gold 1lit/ha+HW	10.60bc	4.54	7991.32abc	2187.67bc	166.10	28.19
Dual-gold 2lit/ha+HW	13.86a	4.50	9204.51a	2640.97a	170.78	28.41
Dual-gold 3lit/ha+HW	10.49bcd	4.14	6817.78cde	1842.22cd	170.87	25.94
one time HW	8.64cd	4.27	5911.21ef	1711.15de	166.50	28.91
Two time HW	10.71bc	4.57	8513.89ab	2379.92ab	174.78	27.72
Weedy check	7.64d	4.03	5529.38f	1427.99e	165.38	24.23
Lsd(5%)	2.95	0.7	1217.8	376.85	ns	Ns
CV(%)	34.44	20.18	20.97	23.48	6.04	4.29

Mean value within column followed by same latter(s) are not significantly different at 5%; LSD= least significant difference P<0.05:HW= (Hand weeding)

Grain yield

All weed management treatments increased grain yield and yield components of field pea over weedy check. The analysis of variance showed that the highest grain yield 2640.97kg ha^{-1}) resulted from Dual –gold 2 liter per hectares plus one time hand weeding and

significantly vary from the weedy check plot but not statistically differ with two times hand weeding. Comparable result obtained in plant height, pods per plant and biomass yield between treatments according to Daba, N.A. *et al.*, 2018.

Thousand seed weight the highest and lowest hundred seed weight were attained in two hand weeding and weedy check treatments respectively which were statistically insignificant among treatments.

Partial Budget Analysis

Marginal analysis is an important step in assessing the results of on farm experiments before making recommendations. For this trial variable cost of dual gold and hand weeding frequencies were considered since both locations are similar. Cost and Benefit Analysis Getting higher profitability lies not only in using appropriate agronomic management but also in lowering costs per unit crop production through higher yields. Therefore, economic analysis is required for making recommendation for farmers from such agronomic experiments. The cost and benefit analysis result indicated that the highest marginal ret of return (3466.77 ETB ha^{-1}) was obtained from the treatments two time hand weeding followed by application of Dual-gold 2lit/ha plus two time hand weeding (1350.56 ETB $ha^{-1)}$. But, in the study area since field pea production is in large scale labor competition is high. So, application of Dual-gold 2lit/ha plus two time hand weeding. Therefore, application of Dual-gold 2lit/ha plus two time hand weeding was produced better grain yield and economic feasible and recommended for improved field pea production in Sinana and Agarafa and similar agro ecologies in south eastern Oromia.

Table 6: Marginal analysis of Dual-gold and Hand weeding frequency on field pea production at Agarafa and Sinana

Treatment	Yield	Total Cost	Marginal Cost	Net Benefit	Marginal Benefit	Marginal ret of Return
Weedy check	1427.99	0	0	57119.6	100	0
one time HW	1711.15	1125	1125	67321	10201.4	906.79
Two time HW	2379.92	1875	750	93321.8	26000.8	3466.77
Dual-gold 1lit/ha	1816.6	1375	500	71289	-22032.8	-4406.56
Dual-gold 2lit/ha	1813.44	2050	675	70487.6	-801.4	-118.73
Dual-gold 3lit/ha	2002.15	3975	1925	76111	5623.4	292.12
Dual-gold 1lit/ha+HW	2187.67	2100	1875	85406.8	9295.8	495.78
Dual-gold 2lit/ha+HW	2640.97	3350	1250	102288.8	16882	1350.56
Dual-gold 3lit/ha+HW	1842.22	4425	1075	69263.8	-33025	-3072.09

CONCLUSION AND RECOMMENDATIONS

Weed is the major production constraints, particularly for field pea production in Bale Highlands, and hence its management is quite paramount important to increase the production and productivity of field pea. Results of these study revealed that two hand weeding can be recommended for field pea farms where labor is not a problem. But, in the study area the use of chemical herbicide is the choice with no options since field pea production is in large scale. So, in areas where labor competition is very high during critical period, pre-emergence application of Dual-gold 2.0 L ha^{-1} supplemented with one hand weeding at the later stage could be used as an alternative weed management. However, further research is required to find out another pre or post-emergency herbicide which can control weed problems without supplemental hand weeding practices.

ACKNOWLEDGEMENTS

The authors would like to thank the Oromia Agricultural Research Institute and Sinana Agricultural Research Center for financial and logistical support

REFERENCE

- Anonymous. (2006). Handbook of agriculture. Indian Council of agricultural Research, New Delhi, 911-918.
- Tripathi, A. K., & Meena, H. N. (2011). Competitive ability of field pea (Pisum ativum L) cultivars with weeds at varying row spacing. *Current Advances in Agricultural Science*, *3*(2), 112-114.
- Chaudhary, S., Rathi, J. P. S., Chaudhary, D. K., & Singh, O. P. (2009). Weed management in field pea (Pisum sativum L) through agronomic manipulations. *International Journal of Plant Science*, *4*(2), 524-526.
- Mishra, J. S. (2006). Efficacy of post emergence herbicides against wild oat in field pea. *Indian Journal of Weed Science*, 38, 140-142.
- Veres, T., & Tyr, S. (2012). Temporal dynamics of weed infestation in the pea for grain canopies in the years 2000-2010. *Research Journal of Agricultural Science*, *44*(2), 123-126.
- Singh, G., & Wright, D. (2006). Effect of weed management on weeds and on the nodulation, nitrogenase activity, growth and yield of pea (Pisum Sativum L), *Acta Agronomica Hungarica*, *54*(4), 469-485.

- Govardhan, J. D., Dar, S., & Bharat, K. A. (2007). Effect of different weed management practices on growth and yield of field pea (Pisum sativum L.). *Agric. Sci. Digest*, *27*, 311-312.
- Jafari, R., Rezai, S., & Shakarami, J. (2013). Evaluating effects of some herbicides on weeds in field bean (Phaseolus vulgaris). *International Research Journal of Applied and Basic Sciences*, *6*(8), 1150-1152.
- Sunday, O., & Udensi, E. (2013). Evaluation of Pre-Emergence Herbicides for Weed Control in Cowpea [Vigna unguiculata (L.) Walp.] in a Forest -Savanna Transition Zone. *American Journal of Experimental Agriculture*, 3, 767-779.
- Salahuddin., Akram, M., & Alluddin. (2016). Impact of various herbicides on dicot weeds in wheat (Triticum aestivum L.). *Current Sci. perspectives*, *2*(3), 45-51.
- Munakamwe. (2008). A physiological study of weed competition in peas (Pisum sativum L.). Unpublished PhD thesis, Lincoln University, Canterbury, New Zealand.
- Hassan, G., Faiz, B., & Marwat, K. B. (2003). Effects of planting methods and tank mixed herbicides on controllinggrassy and broadleaf weeds and their effect on wheat cv. Fakhr-e-Sarhad. *Pakistan Journal of Weed Science Research (Pakistan)*, *9*(1), 1-11.
- Daba, N. A., & Sharma, J. (2018). Assessment of Integrated Weed Management Practices on Weed Dynamics, Yield Components and Yield of Faba bean (Vicia faba L.) in Eastern Ethiopia. *Turkish Journal of Agriculture-Food Science and Technology*, *6*(5), 570-580.

Cite This Article: Tamiru Meleta, Reta Dargei, Dagne Kora, Baharu Dajane (2024). Effect of Chemical and Hand weeding Control Methods on Growth Yield Components and Yield of Field Pea in Bale Highlands, Southeastern Ethiopia. *East African Scholars J Agri Life Sci*, *7*(2), 20-25.