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# Effect of herbicide on crop growth and yield of garlic (*Allium sativum* L.)

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**Abstract**
A field experiment was conducted to study the effect of various herbicides on garlic (*Allium sativum* L.) during *rabi* season of 2016-17 on the black clayey soils of Navsari**.** The experiment involved eleven weed management treatments replicated thrice in randomized block design. The various plant growth and yield varied significantly with application of weed management practices. Significantly higher values of plant height, no. of leaves/ plant and bulb yield were recorded with weed free plots followed by application of Oxyflurofen 0.24 kg/ha (PE) *fb* Fenoxoprop 0.075 kg/ha at 40 DAP at 40 DAP. The average bulb yield (6.86 t/ha) was also higher for the weed free treatment. The IWM treatments Oxyflurofen 0.24 kg/ha (PE) *fb* Fenoxoprop 0.075 kg/ha at 40 DAP at 40 DAP and One HW at 20 DAP *fb* Fenoxoprop 0.075 kg/ha at 40 DAP at 40 DAP were found equally effective.

**Keywords:** Stale seed bed, hand weeding, fenoxoprop, garlic GG-2, yield

## Introduction
India has been known as the "Home of Spices". Garlic is a very popular and valuable spice widely used to enhance nutrition and taste of food. Garlic (*Allium sativum* L.) belongs to family "*Alliaceae*". Asia is the largest garlic producing continent in the world and it contributes more than 80% to the total world garlic production. But, the garlic production is constrained by various biotic and abiotic factors. Garlic crop is highly vulnerable to weed infestation due to its slow emergence. Being a closely planted crop with very small canopy, non-branching habit, sparse foliage and shallow root system, it also requires frequent irrigation and high fertilizer application that aid to variation in weed species and its abundance. Manual weeding in the narrow spaced crop is an expensive and labour dependent affair poses a problem in the era of labour scarcity. Due to unrestricted weed growth yield loss in garlic was up to 94.8% due to weed competition (Anon, 2009) [2]. So, farmers now-a-days opt out and seek the help of chemicals as an effective weed control measures and replace the conventional method of weed control weeds in crops like garlic; to improve its productivity and quality. Application of a single herbicide, even though may provide good control of certain weeds, is often inadequate for satisfactory and cost effective weed control due to build-up of herbicide resistance in weeds. Hence, there is necessary to focus our attention on herbicide rotations to enhance the weeding efficiency, broadening the spectrum of weed control, simultaneously reducing the herbicide and labour requirement.

## Materials and Methods
A field experiment was conducted at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, during *rabi* season 2016-17. The experiment was laid out in randomized block design with three replications and comprised eleven weed management treatments *viz.*, Stale seed bed ($W_1$), Pendimethalin 1.0 kg/ha (PE) ($W_2$), Oxyflurofen 0.24 kg/ha (PE) ($W_3$), Pendimethalin 1.0 kg/ha (PE) *fb* Quizalofop-ethyl 0.04 kg/ha at 40 DAP ($W_4$), Oxyflurofen 0.24 kg/ha (PE) *fb* Quizalofop-ethyl 0.04 kg/ha at 40 DAP ($W_5$), Pendimethalin 1.0 kg/ha (PE) *fb* Fenoxoprop 0.075 kg/ha at 40 DAP at 40 DAP ($W_6$), Oxyflurofen 0.24 kg/ha (PE) *fb* Fenoxoprop 0.075 kg/ha at 40 DAP at 40 DAP ($W_7$), One HW at 20 DAP *fb* Quizalofop-ethyl 0.04 kg/ha at 40 DAP ($W_8$), One HW at 20 DAP *fb* Fenoxoprop 0.075 kg/ha at 40 DAP ($W_9$), Weed free (HW at 20 and 40 DAS: $W_{10}$) and Weedy check ($W_{11}$).

Pre- emergence application of herbicides were applied just after sowing and post-emergence at 20 DAP and at 40 DAP as per treatments using knapsack sprayer fitted with flat fan nozzle by mixing in 500 L of water/ha as per treatment. The soil of the experimental field was clayey in texture, medium in available nitrogen (283 kg/ha), high in phosphorus (48 kg/ha) and available potassium (488 kg/ha). The site was slightly alkaline in reaction (pH 7.8) with normal electrical conductivity (0.71). Net plot size was 1.8 × 1.8 m. The seed of garlic (*cv*. GG-2) was sown in the last week of November with using seed rate of 500 kg/ha with 15 × 10 cm spacing. The crop was raised as per the standard package of practices. Before sowing, field was thoroughly ploughed, leveled and fertilized with recommended doses of NPKS at the rate of 100+50+50+50 kg/ha. 100 per cent P through SSP & S through SSP & AS and 50 per cent N through urea, AS and K was applied through MOP as basal and remaining 50 per cent N was applied in two equal splits at 45 and 90 DAP, whereas 50 per cent K at 90 DAP. Data on growth attribute on garlic were recorded from 10 randomly selected plants taken from each net plot and computing their average. Yield attribute was recorded each net plot from random sample, The bulb diameter was measured as the maximum width recorded by the automatic vernier callipers for ten randomly selected bulbs. The gross realization and net realization in terms of rupees per hectare was worked out on the basis of the bulb yield for each treatment and the prices of the produce prevailing in the market. The cost of cultivation of each treatment was calculated considering the current rate of agricultural operations right from preparatory tillage to harvesting including cleaning as well as market prices of inputs, *viz.*, seeds, fertilizers and insecticides *etc*. involved.

## Results and discussion

### Effect on crop growth

A glance of data in table 1 revealed that plant height at harvest. Significantly higher plant height at (52.0 cm) was observed under Weed free (HW at 20 and 40 DAP) ($W_{10}$) treatment, found to be at par with treatments $W_7$ and $W_9$. The outcome might be the result of pre-emergence application of herbicide that destroyed weeds at the time of germination or before emergence, ensuring a lower weed population and a longer period of weed free environment hence, ensuing least crop weed competition that favoured better plant growth. At harvest, weed free treatment was superior and found to be at par with either pre or/and post emergence application of herbicide. Periodical removal of weeds flora reduced the weed dry weight ultimately increasing plant height. The lower values of plant height was recorded under treatment weedy check ($W_{11}$) which might be due to severe crop-weed competition for resources, which made the plant inefficient to take up maximum moisture and nutrients, consequently reducing the photosynthate production hence adversely affecting the crop yield. These findings are in covenant with those of Panara *et al.* (2015) [8]. Moreover, at harvest maximum numbers of leaves/plant were observed under treatment Weed free (HW at 20 and 40 DAP: $W_{10}$) which was at par with treatment $W_7$, $W_9$ and $W_8$. Further, dry matter accumulation g/plant (Table 1) was significantly influenced under various treatments of weed management recorded highest dry matter with treatment Weed free (HW at 20 and 40 DAP: $W_{10}$) which was statistically at par with $W_7$, $W_9$ and $W_8$.

### Effect of yield

The results pertaining to all the yields attributes (Table 1) clearly indicated that application of herbicidal treatment was significantly improved the yield. While, lower value was recorded under weedy check ($W_{11}$). Further, significantly higher garlic bulb yield was recorded under treatment weed free (HW at 20 and 40 DAS: $W_{10}$), being found to be at par with Oxyflurofen 0.24 kg/ha (PE) *fb* Fenoxoprop 0.075 kg/ha at 40 DAP ($W_7$) and One HW at 20 DAP *fb* Fenoxoprop 0.075 kg/ha at 40 DAP ($W_9$) assimilated significantly comparable yield with weed free. The result might be accredited to the prominent weed control efficiently resulting in enhanced deployment of all the available resources to the optimal level. Thus, plant could harvest more photosynthates and in turn fill their economic sink with proper dry matter partitioning. The superiority of the treatments could be explained on the basis of better growth and higher uptake of nutrients under these practices which are corroborated with the findings of Kumar *et al.* (2013) [4], Sampat *et al.* (2014) [11], Aghabeigi and Khodadadi, (2017) [1], Malik *et al.* (2017) and Siddhu *et al.* (2018) [12]. The lower values of yield was recorded under the unweeded control ($W_{11}$) due to overpowering effect of pre-dominant weeds on the garlic crop due to intense crop weed competition for the available resources. Utmost crop weed competition due to meagre growth and scarcer uptakes of nutrients in the weedy check ($W_{11}$) are in close conformity with those reported by Vermani *et al.* (2001) [14], Singh and Nandal (2002) [13] and Hassanein *et al.* (2012) [3] and Siddhu *et al.* (2018) [12].

### Economics

As far as economics is concerned, all the weed management treatments proved to be superior in term of monetary returns. Amongst the treatments, Oxyflurofen 0.24 kg/ha (PE) *fb* Fenoxoprop 0.075 kg/ha at 40 DAP ($W_7$) secured maximum net realization of □107580 /ha with B: C ratio of 2.16 in garlic bulb crop. However, it was followed by Weed free ($W_{10}$) (□107312/ha with 2.09 BCR). This can be the result of effective and efficient control of weeds by pre- and post-emergence herbicides under conditions of higher contribution of grassy weeds in weed flora. While, weedy check ($W_{11}$) recorded the lowest net realization and B: C ratio (□732/ha with 1.01) (Table 2). The result avowed the verdicts of Vermani *et al.* (2002) [14], Reddy, (2006), Mehmood *et al.* (2007) [7], Sampat *et al.* (2012), Hassanein *et al.* (2012) [3], Patil *et al.* (2015), Panara *et al.* (2017) and Siddhu *et al.* (2018) [12].

It can be concluded from the results of the experiment that Weed free (HW at 20 and 40 DAP: $W_{10}$) recorded higher plant growth and ultimately achieved higher bulb yield but hand-weeding being an expensive and labour dependent affair poses a problem in the era of labor scarcity. To address the problem with a solution, treatment Oxyflurofen 0.24 kg/ha (PE) *fb* Fenoxoprop 0.075 kg/ha at 40 DAP ($W_7$) can be adopted to get higher and profitable results.

| Treatment | Plant height (cm) | No. of leaves/ Plant | Dry matter accumulation (g/plant) | Bulb yield (t/ha) | Net return (Rs./ha) | B:C ratio |
|---|---|---|---|---|---|---|
| Stale seed bed (Destroy one flush of weeds) | 42.1 | 7.9 | 3.0 | 3.81 | 21682 | 1.23 |
| Pendimethalin 1.0 kg/ha (PE) | 44.6 | 8.0 | 3.1 | 4.81 | 50745 | 1.54 |
| Oxyflurofen 0.24 kg/ha (PE) | 43.1 | 8.2 | 2.9 | 4.27 | 35917 | 1.39 |
| Pendimethalin 1.0 kg/ha (PE) *fb* Quizalofop-ethyl 0.04 kg/ha at 40 DAP | 42.9 | 8.3 | 2.8 | 5.3 | 63437 | 1.66 |
| Oxyflurofen 0.24 kg/ha (PE) *fb* Quizalofop-ethyl 0.04 kg/ha at 40 DAP | 43.3 | 8.5 | 2.5 | 4.87 | 52349 | 1.56 |
| Pendimethalin 1.0 kg/ha (PE) *fb* Fenoxoprop 0.075 kg/ha at 40 DAP | 47.3 | 8.7 | 2.9 | 5.96 | 84467 | 1.90 |
| Oxyflurofen 0.24 kg/ha (PE) *fb* Fenoxoprop 0.075 kg/ha at 40 DAP | 51.8 | 10.1 | 3.5 | 6.67 | 107580 | 2.16 |
| One HW at 20 DAP *fb* Quizalofop-ethyl 0.04 kg/ha at 40 DAP | 44.4 | 8.9 | 3.3 | 5.95 | 81648 | 1.84 |
| One HW at 20 DAP *fb* Fenoxoprop 0.075 kg/ha at 40 DAP | 46.5 | 9.0 | 3.4 | 6.48 | 99134 | 2.04 |
| Weed Free (HW at 20 and 40 DAP) | 52.0 | 10.5 | 3.8 | 6.86 | 107312 | 2.09 |
| Control (unweeded) | 40.3 | 7.9 | 1.8 | 3.07 | 732 | 1.01 |
| S.Em.± | 2.4 | 0.6 | 0.2 | 0.28 | | |
| C.D. at 5 % | 6.9 | 1.6 | 0.6 | 0.83 | | |

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