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Chemical Weed Control in Eggplant with Pendimethalin

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Abstract
Weed interference reduces garden egg productivity. Most farmers adopt highly labor-intensive and expensive manual weeding. Employing herbicides reduces manual labor requirements but herbicides known for garden egg productivity are few. The main objectives of the experiment are to assess the weed control usefulness of pendimethalin in garden egg production and assess the concentration effect on herbicide efficacy. Treatments involved were pendimethalin application at 1.0 and 2.0 kg a.i./ha, hand-weeded and un-weeded controls. Weed biomass, weed control efficacy (WCE) and garden egg yields were evaluated. Biomass of weed was significantly lower in pots that received pendimethalin at 2.0 kg a.i./ha (7.2) than at 1.0 kg a.i./ha (13.9 g/pot), while hand-weeded and un-weeded had 0.0 and 42.6 g/pot, respectively. Weed Control Efficacy was in the order of 100.0 (hand-weeded control)> 83.2 (pendimethalin 2.0kg a.i./ha) > 67.4 (pendimethalin 1.0kg a.i./ha) > 0.0% (un-weeded). Higher herbicide concentration gave better weed control and garden egg yield than the lower concentration. Garden egg yields were in the order of 138.9 (Hand weeded) > 104.2 (Pendimethalin 2.0kg a.i./ha) > 50.6 (Pendimethalin 1.0kg a.i./ha) > 32.3 g/plant (Un-weeded). Pendimethalin (2.0kg a.i./ha) significantly reduced weed biomass in garden egg pots with 83.2% WCE and 75.0% garden egg yield relative to hand-weeded controls therefore should be among the herbicides considered for weed control in garden egg productivity.

Keywords: Garden egg, hand-weeded control, un-weeded control, uses of eggplant

1. Introduction

Eggplant is among the healthiest consumable food items and around twenty-five species of eggplants, including wild and domesticated types, with fruits and leaves used in traditional medicine and as vegetables in Nigeria (Bergley, 2009). Eze and Kanu (2014) reported that garden egg has appreciable nutritional contents and that health benefits associated with their consumption include reduction of cholesterol and blood sugar, weight loss, increase in the level of vitamin K and improvement in vision. Minerals such as manganese, potassium, copper, phosphorus and magnesium are substantial in eggplants; it is equally rich in vitamins like niacin, folate, vitamin K and vitamin B1 (thiamine). Garden egg also has phytonutrients like Nasunin (Noda et al., 2000). The usefulness of garden eggs is overwhelming; virtually all parts are useful. In the practice of medicine traditionally, roots of the garden egg are utilized for treating asthma, bronchitis, abdominal worms, and wounds, eggplant fruits are eaten to treat stomach disorders and diabetes (Guiama et al. 2010). Oniah et al. (2010) noted that rice, groundnut, or yam. When kola-nut is

not present, eggplant fruits are offered as a replacement at weddings and ceremonial occasions in most places in present-day Nigeria. Because kola nut caffeine content is high, the
garden egg is becoming a replacement for kola nut. Garden egg is traditionally used in Nigeria for various functions such as marriages, baby dedication/naming and new yam festivals. Fried groundnut is served along with garden egg during seminars and academic conferences and workshops. Strangers and visitors are welcomed with garden eggs in most places (Omovbude and Ikenwa, 2020). The curative values of garden eggplant are numerous and they include: boiling the roots together with sour milk and grain porridge for treating syphilis; craw-craw, a skin infection, is cured using juice squeezed out from the garden egg and mashed with leaves; tamarind is utilized to deoction the root and natron and drunk for the cure of gonorrhea; leaf together with the root are crushed to pulp and mixed with natron for the cure of swollen joint pains and rheumatic disease; any person suffering from horse sickness/nasal catarrh is cured using a dry powder made from the fruit insufflated into the nose through a tube (Dalziel, 1937).

Even though garden eggs are highly cherished and useful and eaten whole in some West African tropical countries like Nigeria, globally a great proportion of people mostly use it in its fresh and cut state. Eggplant browning due to fresh-cutting is an important postharvest challenge consumers and traders of eggplant encounter. Mishra et al. (2012) noted that a phenomenon is noticeably observed in eggplant when it turns brown instantly after cutting. They further reported that cutting garden eggs with a sharp blade resulted in less death of cells and physical injury causing minimal leaching of polyphenol and phenolic oxidase activity thereby resulting in lesser browning. Nuevo et al. (2020) noted that various browning inhibitors commercially available and commonly used in local markets in Philippines are ineffective in suspending eggplant browning due to fresh-cutting. Some browning inhibitors have shown some level of effectiveness but the visual appearance is still poor with degraded peel color added that use of sodium metabisulfite solution on eggplant slices delayed browning effectively.

Nutritional, medicinal and social roles eggplant plays are numerous in human existence, therefore plenty of it is essential to satisfy these needs, such needs are hardly met because eggplant production is fraught with a gamut of challenges such as pests and disease attack, poor soil fertility, and weed interference. Alama et al. (2021) have observed that other factors that hinder crop performance are poor soil fertility, root growth inhibited due to high bulk density because of soil resistance to root penetration, poor aeration, and slow movement of nutrients and water. Obiazi (1991) reported that diseases and pests, weed interference and a dearth of high-yielding varieties are major production challenges of cassava, this holds for eggplant too. For disease and pest attacks, plant breeders have come up with some resistance varieties; some insecticides have been successfully used to control insect attacks in eggplant. Idio and Adinya (2017) successfully used Thionex to control insect attacks in garden eggplants. For soil fertility deficiencies, one way to improve eggplant yield is to apply fertilizer. Idio and Adinya (2017) reported that eggplant fruit yield was highest when N.P.K. (15:15:15) was used at 149 kg/ha and recommended that eggplant production at an optimum level should involve using 148 to 149 kg/ha of N.P.K. (15:15:15) fertilizer and placed about 10 cm from the eggplant. Nwokwu et al. (2020) observed that NPK 15:15:15 fertilizer at 150 kg/ha has given the best eggplant fruit yield among the treatments evaluated.

Weed interference remains an immense problem to tackle in eggplant production. Alama et al., (2019) observed that fertilizer use and land management using data collected from soil tests and environmental evaluation are huge problems to tackle in plant production. Obiazi (2022) reported that weeds are ever-presence in plots and they substantially reduce the quality and yield of crops. Adeyemi and Olaniyi (2008) reported that season-long weed infestation resulted in 87.13% in garden egg yield loss. They added that weed removal was critical at 3-6 weeks from transplanting. Various ways are adopted to minimize weed interference in crops; sometimes certain crop varieties are selected because of their ability to suppress weeds. Certain plants have been implicated in combining appreciable yield with weed suppression. Cassava (TMS 30572) has been implicated to have weed suppressing and high crop yield abilities (Obiazi, 1991). There is scanty information contained in literature about controlling weeds using varying crop varieties in garden eggs (Omovbude and Ikenwa, 2020). Crop performance and weed suppression were better in variety Bello compared with variety Yalo (Omovbude and Ikenwa, 2020). Currently, most farmers adopt highly labor-demanding and expensive manual weeding to control weeds in eggplant. Challenges of high labor input in weed suppression associated with high cost were addressed by Obiazi and Ojobor (2013) and they

suggested the application of herbicides as a way of minimizing labor input which eventually results in less use of labor, resulting in less overall cost. Herbicide use reduces manual labor requirements but herbicides known for garden egg productivity are few. Herbicides identified for the management of weed in eggplant are few; Aliyu and Lagoke (1995) reported that mixtures of metolachlor and chlorbromuron, diflufenican and metobromuron, each at 1.0 + l.0 kg a.i./ha accomplished better suppression than using metolachlor at 2.0 kg a.i./ha because the mixtures controlled weeds effectively and produced fruit yields which were comparable to yields obtained from the hoe-weeded in both years. The herbicides identified for the management of weeds in eggplant are few and are not readily available. It is necessary to investigate more herbicides for weed management effectiveness and eggplant yield. Jordan et al. (1994) noted that dinitroanaline herbicides, such as trifluralin and pendimenthalin, are used commonly in several crops for residual annual grass control. Therefore, the objectives of this study were to evaluate crop yield and weed control efficacy of pendimethalin in eggplant.

2. Materials and Methods

Study area

An experiment was investigated in the Agronomy Departmental farm located in Asaba in the former Campus of Delta State University, in Nigeria; which is located within longitude 60 491E and latitude 60 141N. It has a rainforest ecology. April is when the bimodal pattern of the rainy season begins which ends in November, June and September are the 1st and 2nd peaks of the rainy seasons, respectively. The cucumber seeds purchased from Ogbogono market in Asaba were first planted in a nursery bed on the 25th of February, 2018, the study was terminated on the 27th of May, 2018.

The soil had 813 g kg-1 of sand, 73 g kg-1 of silt while the clay value was 114 kg- soil, textural class is sandy loam. The pH of the soil was 5.7. Fertilizer NPK 15:15:15 was applied at 3.75 g/pot at three weeks after transplanting by side placement at least five cm from the transplanted seedling.

For insect pest control, cypermetrin was used at a rate of one ml/liter of water and sprayed at three, five and seven weeks after transplanting for pest control.

Herbicide application

An area of 2 x 4 m was marked out behind the Agronomy Department. Sprayer calibration was done in the marked-out area. The pots were taken to a marked area, positioned and sprayed and taken under the shade where they stayed overnight to prevent unexpected rain from leaching out the applied herbicides. The following morning, treated pots were taken back to the experimental area.

Planting of eggplant

The seeds for planting were drilled directly into a well-prepared nursery bed. The seeds were first sown in a nursery bed. After three weeks, when seedlings were 5-10 cm high, they were transplanted into the experimental pots after herbicide application, pots for the two controls did not receive herbicide treatment. The eggplants were transplanted into twelve black polythene bags and each pot had an average of 12 kg of soil.

Experimental design

A completely randomized design was employed to lay out the experiment which was replicated three times.

Treatments were: Pendimethalin at 1.0 kg a.i./ha, Pendimethalin at 2.0kg a.i./ha, hand-weeded control and Un-weeded control.

Data collection

Data collected include plant height, stem girth of 10 cm height from soil level, number of leaves, number of garden eggs/plant, fresh weight of harvested eggplants, fresh and dry weights of root, leaves and shoot, fresh and dry weed weight at ten weeks after transplanting.

Data analysis

Data collected were subjected to ANOVA and separated treatment means using DMRT at 5% probability level.

3. Results and Discussion

Growth attributes of garden-egg grown in pendimethalin-treated pots

Leaves count plant was not affected by pendimethalin application at six Weeks After Transplanting (WAT) (Figure 1.0), it ranged from 6.0 to 7.3/plant; the effect became significant at eight WAT when plants grown in higher concentration of herbicide had 22.0 leaves which were similar to 26.3 leaves/plant in plant in weed-free pots, but greater than 16.7 leaves/plant in for plants grown in pots that received lower dosage of pendimethalin, the least leaf count was observed in un-weeded pots (Figure 1.0). The trend at six WAT was not different from that of eight WAT, only that pants in a higher concentration of herbicide now have a greater number of leaves than the ones in the lower concentration. Leaf count per plant was affected by pendimethalin application at ten weeks after transplanting (Table 1), hand weeded control pots had the greatest number of leaves per pot (106) was more than the leaf count per plant in pendimethalin-treated pots (46.5- 50.6). The lowest leaf count per plant (25.4) was found in weedy pots.

Plant height was affected by the pendimethalin in pots used to grow garden eggs (Table 1). Eggplants in pendimethalin-treated pots had plant heights of 65.7 to 66.1 cm which was similar to garden egg height in hand-weeded pots (65.3 cm), these heights were greater than 52.7 cm, the height of plants grown in the weedy pots.

Branches per/plant and girth of stem at 10 cm height were not affected by the treatments (Table 1). Treatments did not affect branches /plant did not affect, it ranged from 7.6 in weedy pots to 11.1 in pots treated to pendimethalin at 2.0 kg a.i./ha. Similarly, stem girth ranged from 4.2 in weedy pots to 5.3 in hand-weeded pots.

Weed control attributes of pendimethalin in eggplant productivity

Weed fresh weight was significantly affected by the treatments, the hand-weeded pots had very minimal fresh weed weight which was significantly less than that of other treatments (Table 2). The highest weed fresh weight (64.9 g/pot) was obtained from the weedy pot, it was larger than 17.8 g/pot obtained in pots with the lower herbicide concentration. Similarly, Obiazi (2022) reported the highest weed biomass in the weedy check. Pots that received the higher herbicide concentration had less weed weight in comparison to the pots that received a lower herbicide concentration.

Pots sprayed with a higher rate of the pendimethalin had significantly less weed dry-weight (7.2 g/pot) compared to 13.9 g/pot obtained in the pots that received 1.0 kg a. i./ha pendimethalin. Doubling the herbicide concentration resulted in about 48.0 % further drop in weed biomass. Weedy pots had weed biomass of 42.6 g/pot. Herbicide concentration affected by Weed Control Efficacy (WCE). Pendimethalin at lower concentration had 67.4 % WCE 10 weeks after transplanting; doubling the concentration pendimethalin increased the WCE to 83.2% at that growth stage.

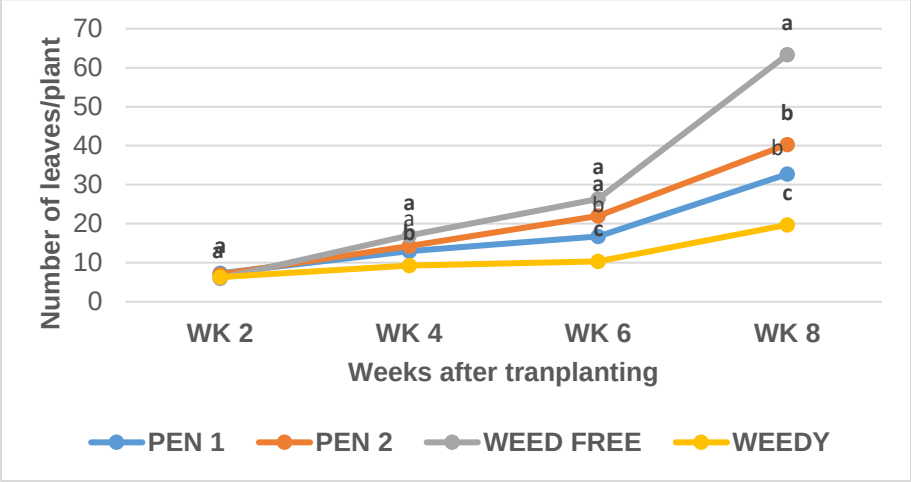

Figure 1.0 Effect of pendimethalin leaf count per plant between two to eight weeks growth stage

WK =week, PEN 1 = Pendimethalin at 1.0 kg a.i./ha, PEN 2 = Pendimethalin at 2.0 kg a.i./ha, WEED FREE= Pots kept weed free by constant hand-pulling of weeds, and WEEDY = Un-weeded pots.

Table 1: Effects of pendimethalin on leaf count, plant height, and number of branches per plant at thirteen weeks growth stage

Weed control method	Number of leaves / plant	Height of Plants (cm)	Number of branches / plant
Pendimethalin at 1.0 kg a.i./ha	46.5 b	65.7 a	8.3 a
Pendimethalin at 2.0 kg a.i./ha	50.6 b	66.1 a	11.1 a
Hand weeded control	106.0 a	65.3 a	10.2 a
Weedy check	25.4 c	52.7 a	7.6 a
SE ±	5.33	4.19	1.57

Means of with the same letter(s) in a column are not significantly differ using DMRT at 5% probability level.

Yield attributes of eggplant in pendimethalin-treated pots

Consistently, eggplants grown in weedy pots had the least plant biomass (leaf+ shoot + root) dry weight per pot (14.9 g/pot (Figure 3) and the least fresh garden egg yield/pot (32.3 g/plant) (Figure 4); it was only in number of garden eggs per plant that weedy pot had 1.4, which was similar to 1.9, the number of garden eggs/ plant in pots sprayed 1.0 kg a. i. kg/ha of pendimethalin (Figure 2.0). Herbicide concentration affected the number of garden eggs/plant, the higher concentration had plants with 3.6 garden eggs/plants while the plants grown in pots that received the lower concentration of the herbicides had significantly less number of garden eggs per plant (1.9/plant) (Figure 2.0). A combination of the variety Bello and pendimethalin had the highest profit than in other treatment combinations. Therefore, combining a variety Bello and pendimethalin is recommended for use in places where they are carried out the study (Omovbude and Ikenwa, 2020). The highest plant biomass (leaf+ shoot + root dry weight) 73.5 g/plant, the highest number of eggplant per plant (4.8) and the highest fresh garden egg yield of (138.9 g/plant) obtained from hand-weeded pots was superior to what the plants grown in the other treatments produced ((Figure 3.0)). Hand weeding has similarly given the highest yield of the garden egg as reported by Almhemed and Ustuner (2022 (who noted that hand hoeing gave the best weed management in eggplant, plastic mulch with black color was second best and pre-emergence pendimethalin application was the third best weed control treatment.

Values of the parameters were greater in the pots where the higher herbicide concentration was used than in the pots where the lower concentration of herbicide was used.

The safety of tolerant vegetables in pendimethalin application at 2.0 kg a.i./ha has been reported; Almhemed and Ustuner (2022) observed that pendimethalin treatment has shown symptoms of slight phytotoxicity on eggplant thirty days after pre-emergence application but disappeared shortly after. Similarly, Obiazi et al. (2020) reported that pendimethalin sprayed pre-emergence at 2 kg a.i./ha showed no phytotoxic effect on okra.

4. Conclusion

Pendmethalin has been used successfully for weed control in some vegetable crops like okra (Obiazi et al., 2020). The suitability of pre-emergence application of pendimethalin for weed management in eggplant was tested at 1.0 and 2.0 kg a;i./ha along with hand-weeded and un-weeded controls. The suitability of the herbicide has been established, especially at the higher concentration because pendimethalin (2.0kg a.i./ha) significantly reduced weed biomass in garden egg pots with 83.2% WCE and 75.0% garden egg yield relative to hand-weeded controls.

Table 2: Effect of pendimethalin on garden egg stem girth, weed fresh weight and weed dry weight per pot at thirteen weeks growth stage

Weed control method	Stem girth (cm)	Weed fresh weight (g/ plant)	Dry weight of Weed (g/plant)
Pendimethalin (1.0 kg a.i./ha)	4.5 a	17.8 b	13.9 b
Pendimethalin (2.0 kg a.i./ha)	4.9 a	11.3 c	7.2 c
Hand-weeded control	5.3 a	0.3 d	0.0 d
Weedy check	4.2 a	64.9 a	42.6 a
SE ±	0.64	2.5	2.07

Means of the same letter(s) in a column are not significantly different using DMRT at 5% Probability level.

The suitability of pendimethalin for weed management in eggplant at 2.0 kg a.i./ha has been established, the higher concentration of 2.0 kg a.i./ha performed significantly better than the lower concentration by having a fruit yield of 75% of hand-weeded control while the lower concentration had a yield of 36.4% relative to yield from hand weeded pot. Pendimethalin should be listed for weed control in eggplant, the advantage of identifying pendimethalin is that it is readily available because of its commonplace in the productivity of several crops like rice, soybeans and groundnut.

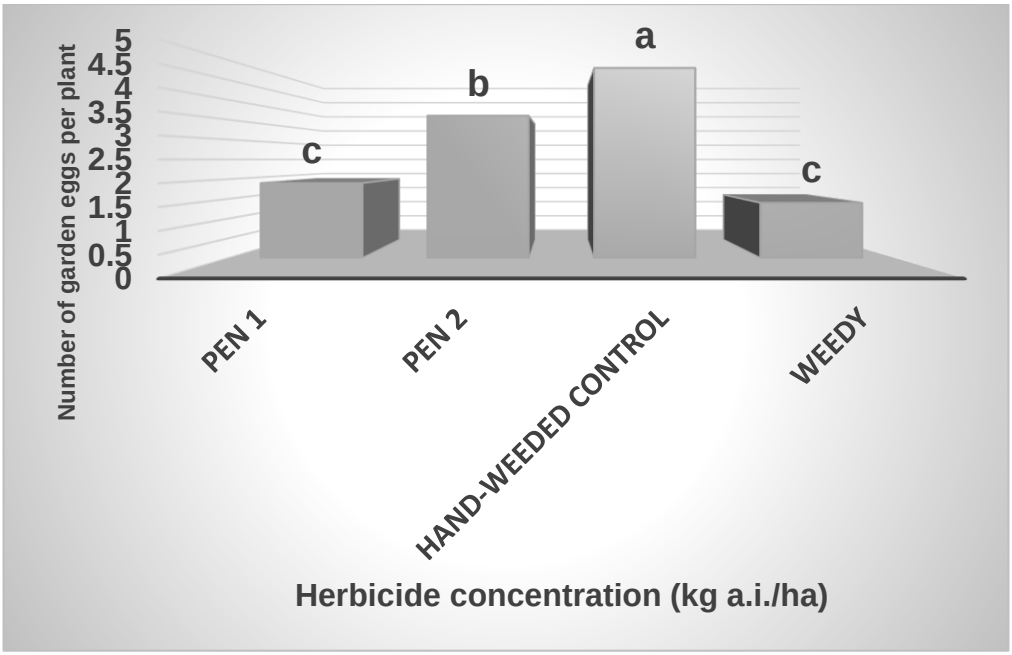

Figure 2: Effects of pendimethalin concentration on number of garden egg per plant.

Note: Bars of similar letter(s) are significantly not different at probability level of 5%.

Figure 2 Effects of pendimethalin concentration on number of gardenegg per plant.

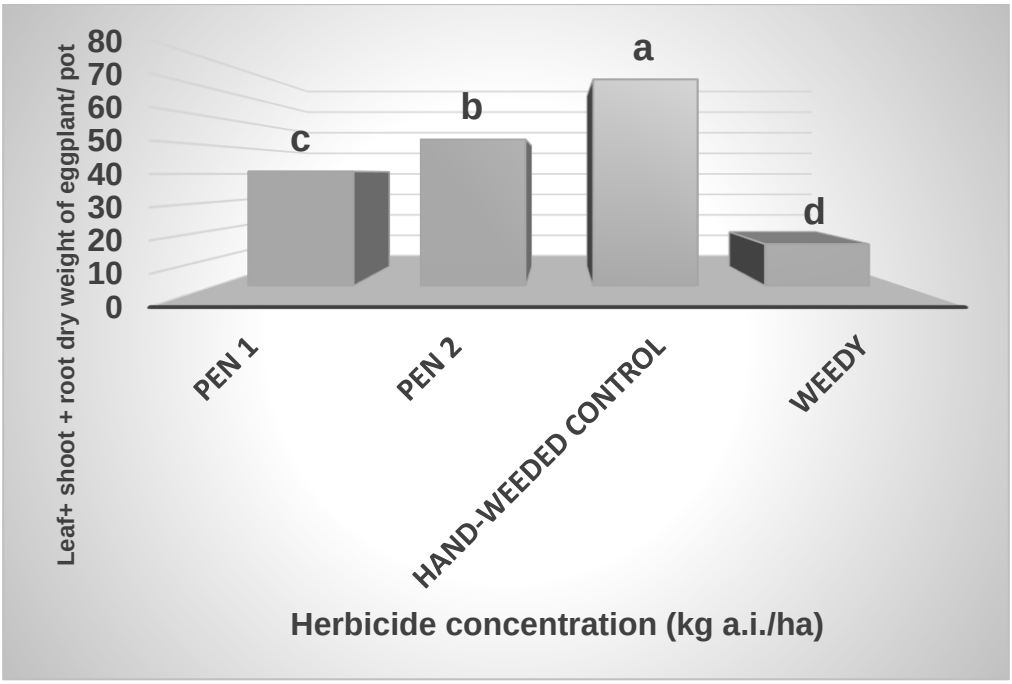

Figure 3: Effects of pendimethalin concentration on leaf+ shoot + root dry weight of eggplant per pot.

Figure 3 Effects of pendimethalin concentration on leaf+ shoot + root dry weight of eggplant per pot.

Note: Bars of similar letter(s) are significantly not different at probability level of 5%.

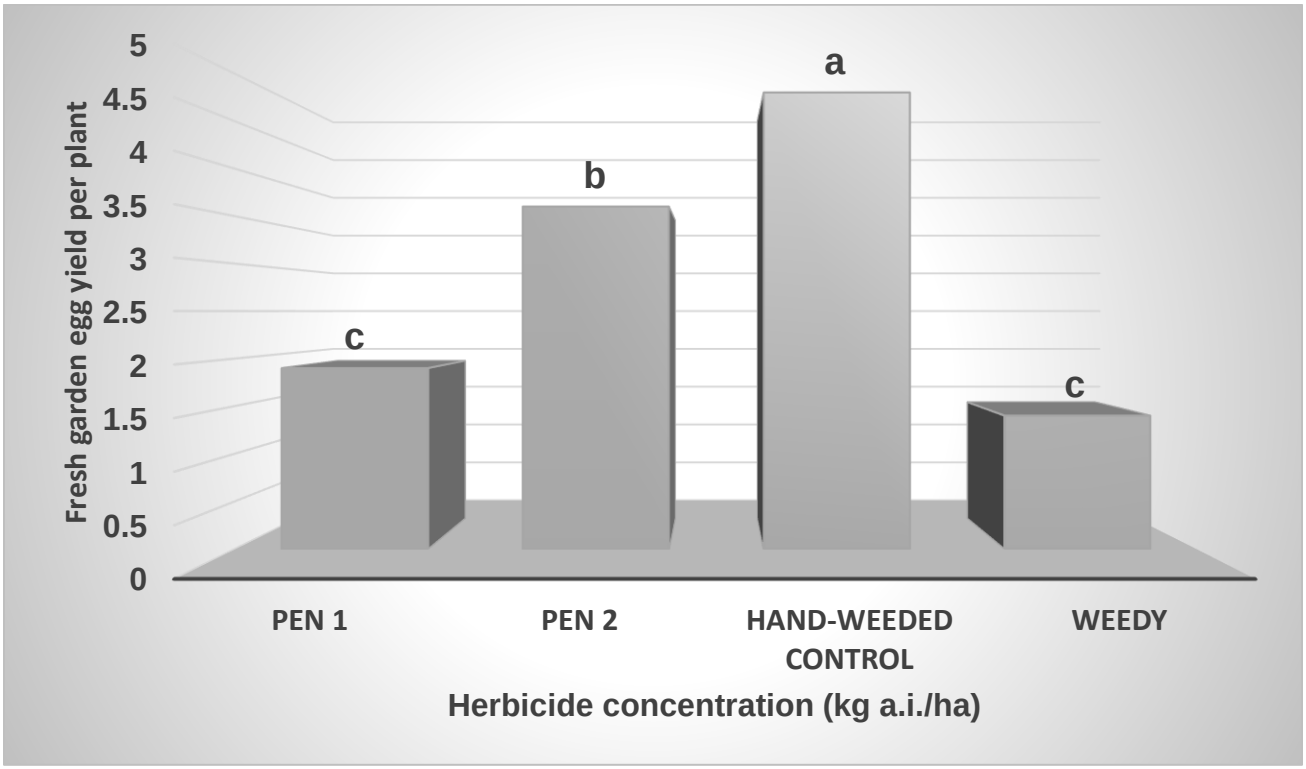

Figure 4 Effects of pendimethalin concentration on fresh garden egg yield per plant.

Note: Bars of similar letter(s) are significantly not different at probability level of 5%.

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