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EFFICACY OF PRIMEXTRA GOLD IN CONTROLLING WEEDS OF MELON (*Citrillus lanatus* (Thunb.) Matsun and Nak.)

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ABSTRACT

A field experiment was conducted in the Center of Ecological Studies, University of Port Harcourt, Rivers State to evaluate the efficacy of Primextra Gold (290g /l S – Metalochlor and 370g/l Atrazine) herbicide in controlling weeds in melon and to determine its safety for use in melon. The experiment was carried out between the months of February and March, 2013 and was laid out in a completely Randomised Design with four replications. Seven weed control treatments – 0.0, 0.25, 0.5, 0.75, 1.0, 1.25and 1.5 kg a.i/pot – were applied post plant, pre-emergent for this study. The dry weight, height of plant, number of green leaves, weed control efficiency, weed persistence index, crop phytotoxicity rating, weed destruction rating, weed count (total number of weeds), weed flora and classification were used to determine the herbicide efficacy and crop safety. Results show that the effects of the treatments were mostly significant; treatments higher than 0.75kg a.i/pot were more toxic to the melon. Injury caused by lower treatments (0.25 – 0.75kg a.i/pot) to the melon reduced over time while injury caused by higher treatments (1.0 – 1.5kg a.i/pot) increased over time. Treatment 0.75kg a.i/pot resulted in the highest height (72cm/pot), highest number of leaves (20.3/pot), second highest dry weight (2.98g/pot) at 28 DAT. The study also showed that Primextra Gold has a high Weed Control Efficiency (WCE %) and the Weed Persistence Index (WPI) of the weeds was low. The most common weeds observed were Oldelandria corymbosa, Phyllantus amarus, Oplismanus burmanii and Digitario sp., as they occurred in the untreated pots and in virtually all treated pots.

Key Words: DAT- Days-after-treatment, Primextra Gold, Melon, weed control efficiency, weed control treatments.

INTRODUCTION

"The world population is close to 6 billion and is expected to reach 8.5 billion by the year 2025. According to the figures provided by the recent World Food Summit (FAO, 1996), the number of undernourished in developing countries by the year 2010 will be between 700 and 800 million. The increase in population is in parallel with a decrease in cropland areas. For this reason food production in the existing crop areas must be increased in order to sustain the growing population and this can only be attained by increasing crop yields and improving cropping intensity”(Labrada, 1997).

Expected rise in world population to nearly 9 billion by 2050, low available arable land to population ratio, encroachment of infrastructures, declining investment in the agricultural sector, are some of the factors that challenge food production (FAO, 1996). According to the Food and Agriculture Organization of the United Nations or FAO, weed, pest and disease have already resulted in the annual loss of about 20 to 40 percent of the world's potential crop production.

As cited by Kostov and Pacanoski (2007), weeds are crops’ oldest problems and have largely limited profitable crop production. Weeds have been a problem in natural resource management and have caused significant losses in agriculture, forestry, fishery, water supply and other human enterprise. They also pose danger to the health and quality of human life. (Kostov and Pacanoski, 2007). While the outbreak of insects and disease pathogens are sporadic, the presence of weeds are relatively constant (Gianessi and Sankula, 2003).

Of about 10% of plant species that represent the weed population, 1,800 of them are of importance as they cause significant economic loses in crop production and 300 of them are a nuisance to cultivated crops around the world (Ware and Whitacre, 2004).

There is a limited availability of herbicides for melon (Tickes, 2012;Sosnoskie, *et. al*., 2013). Major crops have being received the most attention in research, development and registration of herbicides; corn, soybeans, grains, cottons and sugar beets while minor crops such as high value vegetable crops have attracted very little or no screening efforts. Mechanical tillage and cultivation, hand hoeing and the use of a limited number of herbicides are employed in the production of crops such as melons, lettuce, onions and carrots in the desert Southwest U.S. (Umeda, *et. al*., 2000). MacLeod (2001) also reported that as at 1997, only one herbicide was registered for use in cucurbits which controlled only grasses and due to the absence of registered herbicides, “weeds are probably the most important cause of cucurbit yield loss”. According to Shiboleth, *et al*. (2001), in the past decade, no new herbicides have been labelled and none are known to be under development for cucurbits. The need to identify subject matter specialist capable of evaluating weed infestation and problems with the aim of making sound herbicide recommendations has been sugested(Gianessi and Williams, 2011).

This study intends to expand the range of herbicides used in cucurbit especially melon by screening Primextra Gold for its safety on melon and provide growers with a potential alternative herbicide for use in melon.

Primextra Gold which is a recently introduced herbicide in Nigeria has not been widely tested by farmers. It is used to control annual grasses and broad leaf weeds in maize, sugar cane, sweet corn and oxabetrinil (Concep safener) treated sorghum. Hence, the objective of this study is to assess the effectiveness of the pre-emergent herbicide, Primextra Gold, for weed control in melon and its effect on the crops.

MATERIALS AND METHODS

The field experiment was conducted between February and March, 2013 in the green house of the Centre of Ecological studies with a coordinate of Longitude N 04^{O} 54’ 16.1”, latitude 006^{O} 55’ 23.3” and altitude 4m above sea level in the University of Port Harcourt, Rivers state, Nigeria. The experiment was laid out in a randomized

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complete block design with four replications (Table 1).
Six (6) seeds of melonwere planted in each container. Melon seeds (*Citrillus lanatus*), obtained from the local market were used for the experiment. Primextra Gold was applied preemergence with CO_2 pressurized backpack sprayer and the soil was not devoid of moisture as at the time of application.

Table 1: Treatments applied

Treatments	Primextra Gold Concentration Kg a.i / pot	Primextra Gold Concentration kg ai/ ha
T1	Control – 0.0 kg a.i/pot	0.00 kg ai/ ha
T2	0.25 kg a.i/pot	0.379 kg ai/ ha
T3	0.5 kg a.i/pot	0.758 kg ai/ ha
T4	0.75 kg a.i/pot	1.136 kg ai/ ha
T5	1.0 kg a.i/pot	1.515 kg ai/ ha
T6	1.25 kg a.i/pot	1.894 kg ai/ ha
T7	1.5 kg a.i/pot	2.272 kg ai/ ha

Weed Data Collection
Following are the observations recorded and the techniques followed.
*Weed count***:** The total number of weeds present was recorded at 14 Days after treatment (DAT) and 28 Days after treatment (DAT) by identifying and counting the weeds present in each of the pots. The density was expressed as number of weeds per pot and subjected to statistical analysis. The various weed species were categorized as either broadleaf, grasses or sedges.
*Dry weight of weeds***:** Melon shoots were cut at 28 Days after treatment(DAT) at the soil surface and the collected samples were oven-dried at 70^0C to a constant weight, weighed and results recorded. Dry weight of weeds per pot was worked out and expressed in g per pot and subjected to statistical analysis.
Weed Control Efficiency % (WCE)**:** It expresses the percentage (%) reduction in weed population due to weed management practices over control. The weed control efficiency was calculated as follows:
Weed Persistence Index (WPI)**:** Is used to indicate the resistance of weeds against various tested treatments and to confirm the effectiveness or the herbicidal efficiency of the selected treatments to kill the weeds (Denasenapathy, *et al*., 2008). It was calculated using the weed count and the dry weight of the weeds.
*Weed control rating***:** Visual ratings of weed destruction were taken 7, 14, 21 and 28 Days after treatment (DAT) to determine the extent of destruction caused by the herbicide treatments on weed using a scale of 0 – 100.

Data Collection
Growth components: For recording, the various growth components were taken at 7, 14, 21 and 28 Days after treatment (DAT). Plant dry weight, height, leaf number were used as quantitative measure representative of plant vigour.
Plant height (cm)**:** The plant height was measured from the base of the plant (at soil surface) to the tip of the main shoot of theplants and mean of plant height was

worked out and expressed in centimeters per pot.

Number of green leaves per plant: The numbers of leaves were obtained by physical count of the leaves in the pots and average number of leaves per pot was worked out.

Dry weed biomass: Samples were taken at 28Days after treatment(DAT). Their shoots were cut at the soil surface and the collected samples were oven-dried at 70^0C to a constant weight, weighed and results recorded.

Crop phytotoxicity: Visual ratings of crop toxicity were taken 7, 14, 21 and 28 Days-After-Treatment (DAT) to know the extent of toxicity caused by the herbicide treatments on melon using a scale of 0 – 100 (Willard, 1958).

Statistical Analysis: The data collected for each of the parameter were subjected to analysis of variance (ANOVA and means separated using LSD test at 5% level of probability.

RESULTS AND DISCUSSION

There was no weed control in the untreated pots; therefore, the percentage weed destruction was zero (0). Treatment 0.25kg a.i/pot generally had moderate effects on the weeds except at 7 DAT. Treatment 0.5kg a.i/pot caused severe weed destruction indicating satisfactory to good weed control at 7, 14, and 21 DAT and a less than satisfactory weed control at 28 DAT. The effect of treatment 0.75kg a.i/pot was severe. Its effect ranged from satisfactory to good weed control at 14 and 28 DAT and very good to excellent weed control at 7 and 21 DAT. Treatments 1.0 – 1.5 kg a.i/pot resulted in complete weed destruction of the weed at all stages except at 7 DAT where treatment 1.0kg a.i/pot caused severe effect. The effect of the herbicide wore off over time as is observed in the percentage weed control overtime.

Herbicides are expected to kill weeds and protect our crops from weed competition without harming the crop. Cucurbits are generally more susceptible to injury from most herbicide applications, including registered herbicides and managing the diversity of broadleaf weeds and sedges in cucumber, squash and pumpkin fields is difficult.

In melon crops, treatments 0.25kg a.i/pot caused some crop discolouration and stunting at 7DAT but by 14 DAT, the injury was more pronounced but not lasting. At 21 and 28 DAT, its effect reduced to slight crop stunting. At 7DAT, treatments 0.5 kg a.i/pot resulted in a more pronounced but not lasting crop injury and 0.75kg a.i/pot caused a moderate injury which the melon has a chance of recovering from respectively. Both treatments resulted in a non-lasting but more pronounced crop injury at 14 DAT while at 21 and 28 DAT, 0.5 kg a.i/pot of the herbicide resulted in slight stunting. The effect of 0.75kg a.i/pot reduced from a non-lasting crop injury at 21 DAT to some crop discolouration with stunting at 28 DAT.

Melon treated with 1.0 – 1.5kg a.i/pot of the herbicide suffered injuries which ranged from moderate at 7DAT to severe at 14 DAT and complete at 28 DAT. At 7DAT, the crop injury was more lasting with recovery doubtful for melon treated with 1.0-1.5kg a.i/pot. At 14 DAT, treatment 1.0kg a.i/pot nearly destroyed all the melon leaving only a few surviving plants; at 21 and 28 DAT, the melon crop suffered heavy injury and stand loss. Melon which received 1.25kg a.i/pot of the herbicide had only occasional live crops left at 14 and 21 DAT and the effect of the herbicide reduced at 28 DAT leaving only a few surviving plants since the crops were nearly destroyed.

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There was complete destruction of melon that received 1.5kg a.i/pot of the herbicide at all stages of the melon except at 7 DAT where the crop injury was more lasting and recovery doubtful.

Effect of herbicide treatments on total number of weeds**:** The total number of weeds was significantly reduced. The untreated pots showed significantly higher number of weeds than the treated pots (Fadayomi *et al.*, 1984; Babu, 2008; Singh *et al.*, 2013). The number of weeds decreased with increased herbicide treatments showing the efficiency of increased treatment of the herbicide in reducing weed density (Fig.1). This result is in agreement with Hafeezullah (2000),Sobotka and Barlow (1983) and Khan *et al.*, (2003) who reported that weed control methods significantly affects weed density m^{-2}. Low weed density observed in the herbicide-treated pots could be attributed to effective weed control of the herbicide and its ability to control weed beyond the critical period of growth (Sunday and Udensi, 2013). The smothering effect of the melon cover may also have contributed to the low number of the weeds judging from low weed population and low weed dry weight and this was also reported by Sunday and Udensi (2013) in cowpea.

Effect of herbicide treatments on dry weight of weeds**:** The dry weight of weeds rather than the weed number serve as a better parameter which can be used to measure (Babu, 2008). In this study, the statistical analysis of the data showed that there was significant difference in the effects of the various herbicides treatments on the weed dry weight. The untreated pots had significantly higher dry weight of weeds than the treated pots (Khan, *et al.*, 2003) (Fig. 2). Melon pots treated with 0.5, 1.0, 1.25 and 1.5kg a.i/pot had the least recorded dry weight of zero (0). The lower weed dry weight observed in the treated pots may be ascribed to lesser number of weeds. The low dry weight of weeds may also be as a result of effective control of the weeds by Primextra Gold through suppression of weed growth and reduction of weed population per unit area (Mutnal, 2006). Due to the differential efficacy of the treatments in suppressing weed growth, the weed dry matter reduced as treatment increased showing that higher concentrations of the herbicide controlled the weeds to the minimum.

Effect of Primextra Gold on dry weight of melon: "The total dry matter produced is an indication of the overall utilization of resources and better light interception" (Babu, 2008). The pre-requisite for getting higher yield in any crop is higher total dry matter production and its distribution to the various plant parts and the distribution of dry matter in leaves, stem and reproductive parts indicate greater biological efficiency (Mutnal, 2006). The highest dry weight was recorded in the controland in melon treated with 0.75kg a.i/pot. Dry weight of melon was recorded for all treatments except treatment 1.5kg a.i/pot. Treatments of the herbicide reduced the melon dry matter compared to the dry weight of the control while treatments higher than 0.75kg a.i/pot resulted in relatively lower dry weight of the melon, implying that concentrations of the herbicide above 0.75kg a.i. a.i/pot significantly and adversely affected the melon (Fig. 3).

Efficiency of herbicides in controlling weed is affected by the weed flora composition and their pattern of emergence during the growing season (Khaliq, *et al.* 2013;Adigun *et al.*, 2005). There was a significant reduction of weeds with increased herbicide concentrations. The untreated pots recorded significantly higher density and diversity of weeds than the treated pots indicating that the herbicide treatments significantly reduced the weed density and diversity. There were fewer weeds at 14 DAT compared to the number of weeds at 28 DAT indicating that the efficacy of the herbicide treatments reduced with time. New weeds were observed in all the pots by 28 DAT and the untreated pots had a relatively higher density and population of weeds which reduced significantly with the herbicide application. The most common weeds found in the melon pots were *Oldelandria corymbosa, Phyllantus amarus, Oplismanus burmanii* and *Digitario* sp., as they occurred in the untreated pots and in virtually all treated pots.

Throughout the stages of melon growth, the broadleaf weeds recorded the highest density followed by sedges and grass weeds respectively (Hasanuzzaman, Ali, Alam, Akhter, & Alam, 2009). There was a general decline in broadleaf weeds and grass weeds with application of the herbicide (Khan, *et al.*, 2003), while, sedges were found only in untreated pots at 14 DAT and at 28 DAT, they were found in the control and where 0.25kg a.i/pot of the herbicide was applied. The results showed that the application of Primextra Gold successfully eliminated sedges from all the treated pots even up to a 100%. Khan, *et al.*,(2013),have also reported best control of broadleaf and grass weeds in maize by Primextra Gold.

Effect of herbicide treatments on the height of the melon**:** The heights of melon were significantly affected by the herbicide treatments. From the result (Fig. 4), the highest height was recorded in the control at all stages except at 28 DAT.Treatment 0.75kg a.i/pot caused the highest height at 28 DAT (it was higher than the control). Therefore, treatment 0.75kg a.i/pot not only controlled the weed density efficiently, it also improved melon growth over time as is evident in the height.

Effect of the herbicide treatments on the number of melon leaves**:** The leaves play a major role in a plant as they are organs of photosynthesis in vascular plants; they function as the food and energy conversion source of the plant (Forstbauer, 2010).

Generally, the untreated melon showed higher number of leaves compared to the treated ones (Fig. 5). Melon which received 0.25, 0.5, 0.75kg a.i/pot of the herbicide had virtually the same number of leaves at all stages. As observed in the dry weight and height of the melon, the number of leaves recorded for treatments higher than 0.75kg a.i /potreduced indicating that concentrations of the herbicide higher than the 0.75kg a.i /pot had more toxic effect on the melon.

Weed Control Efficiency expresses the percentage (%) reduction in weed population due to weed management practices over control. The WCE for untreated pots was zero (0) since there was no control of weeds (Fig. 6). The Weed Control Efficiency (WCE %) of the various concentrations of Primextra Gold observed at 14 DAT generally increased across the treatments; from the lowest treatment (0.25kg a.i /pot) to the highest (1.5kg a.i /pot). At 28 DAT, (WCE%) of the herbicide was higher except in melon pots treated with 0.25kg a.i /pot,where it dropped from 81.6% at 7 DAT to 67.7% at 28 DAT. This drop in WCE%may be due to the inability of the low concentration (0.25kg a.i /pot) to sustain a control on the weeds overtime and may also be attributed to the emergence of some new weed species at this stage (Hasanuzzaman, *et al.*, 2009)

The Weed Control Efficiency (WCE %) of the herbicide treatments was above 50% for all treatments at all stages and even up to 100% in some, indicating the capacity of the

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herbicide concentrations to control weeds by reduction even to the point of complete weed destruction.

A lower weed persistence index value means a higher level of weed control efficacy of a given treatment and vice versa (Khaliq, *et al.,* 2011). The Weed Persistence Index (WPI) of the weeds was very low (0) for almost all the treatments, indicating that the weeds had low resistance to the herbicide treatments and that the herbicide was very efficient in controlling or eradicating the weeds (Fig. 7).

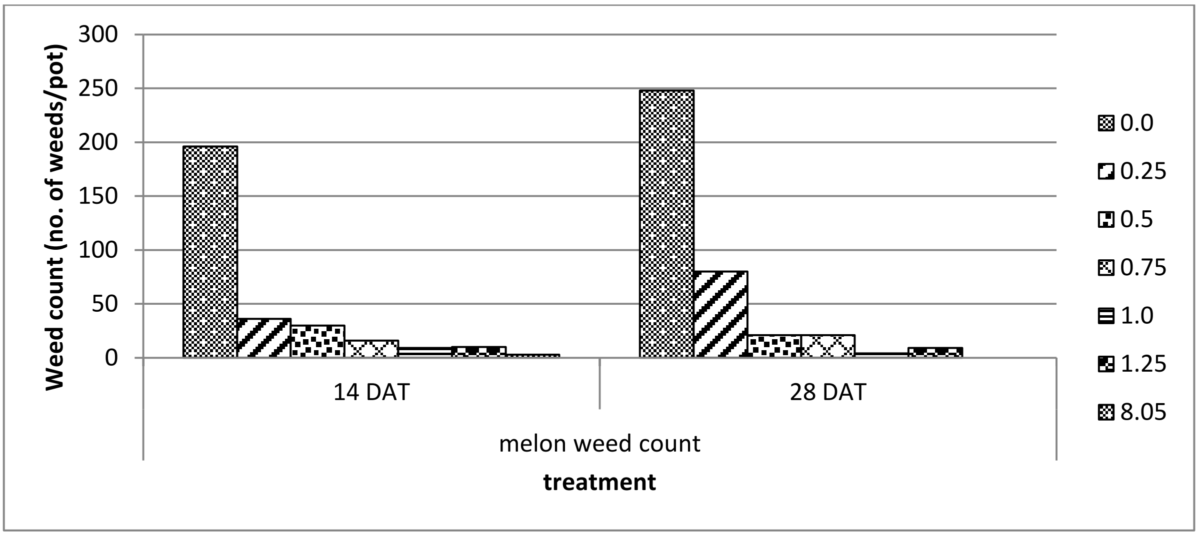

Fig. 1: Weed count at 14 and 28 DAT

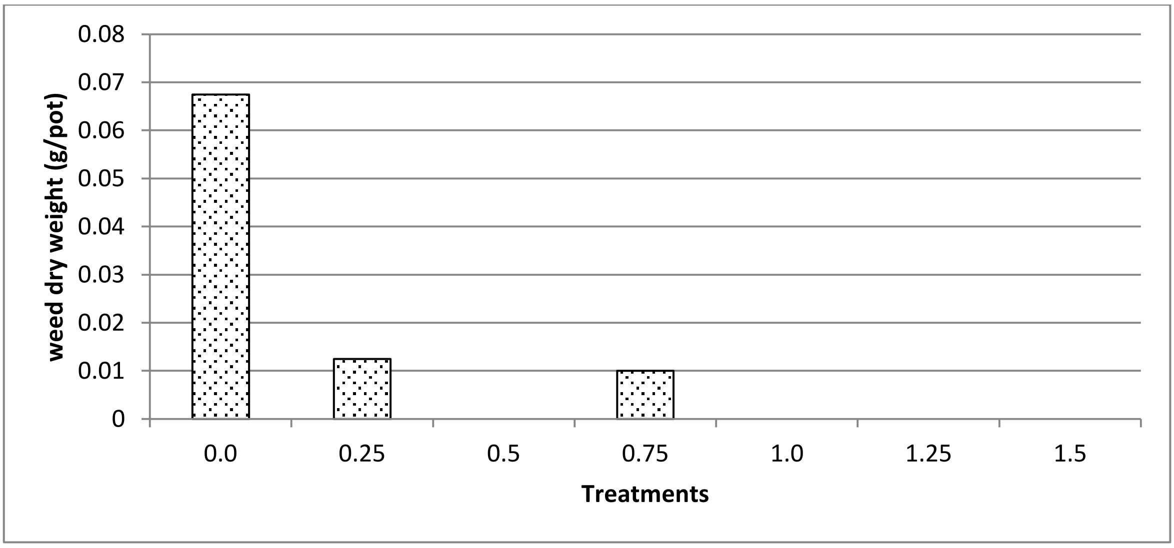

Fig. 2: Effect of the herbicide on the weed dry weight

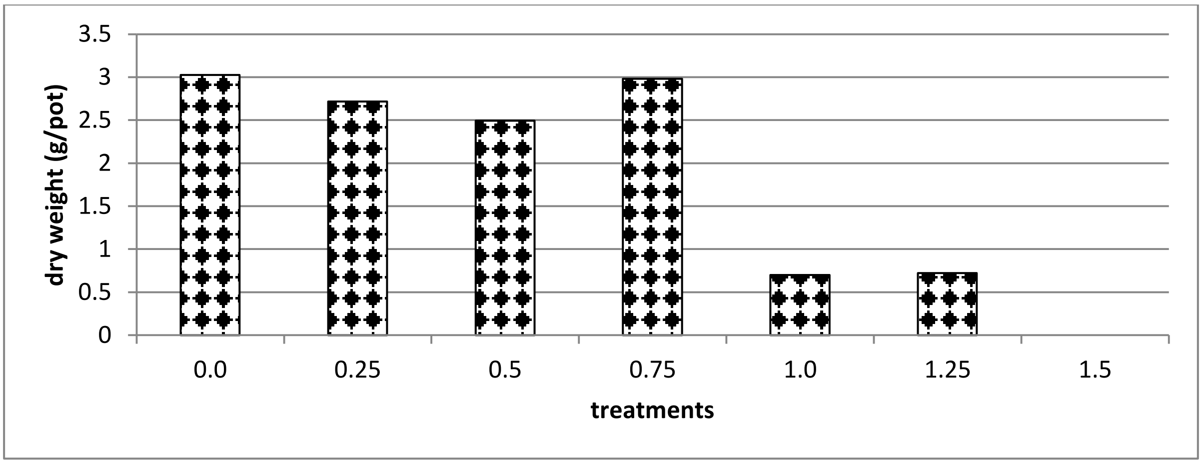

Fig. 3: Effect of the herbicide treatment on melon dry weight at 28 DAT

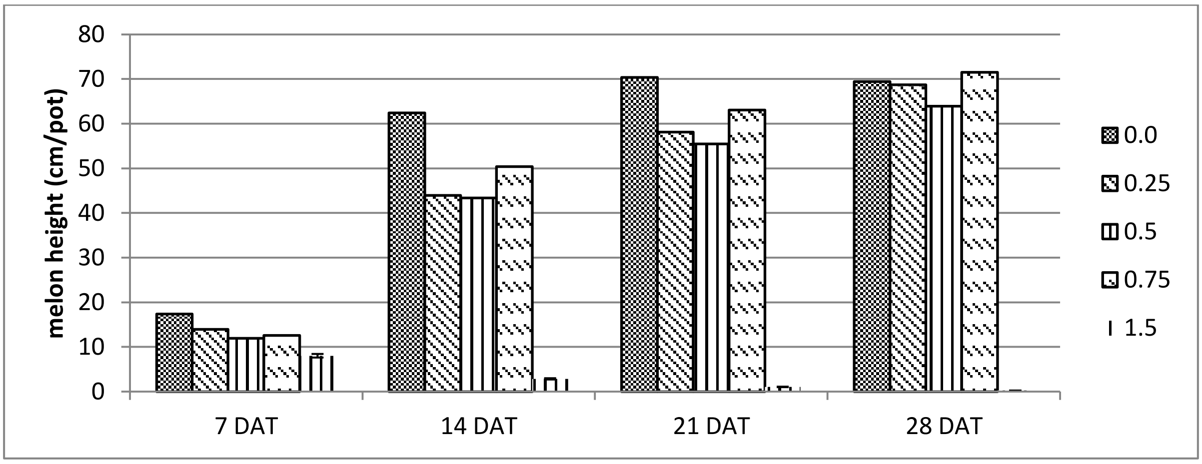

Fig. 4: Effect of herbicide treatments on melon height at different stages of growth

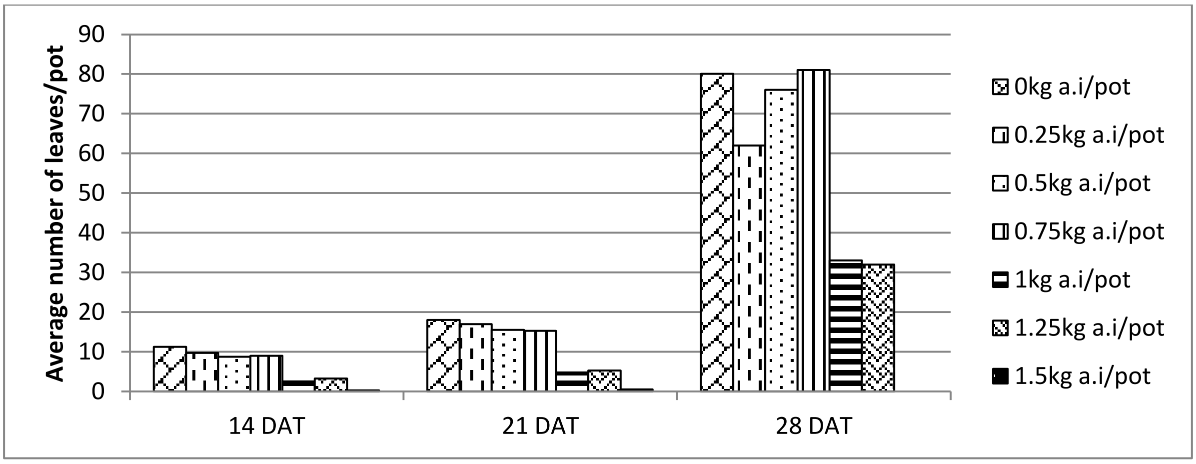

Fig. 5: Effect of herbicide treatment on leaf number at different stages of growth

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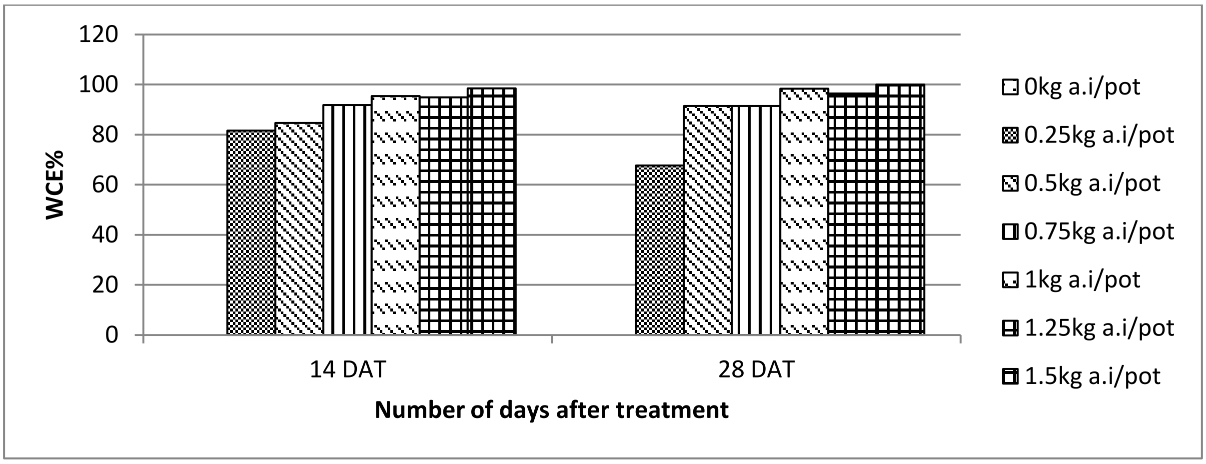

Fig. 6: Weed Control Efficiency (WCE%) of Primextra Gold

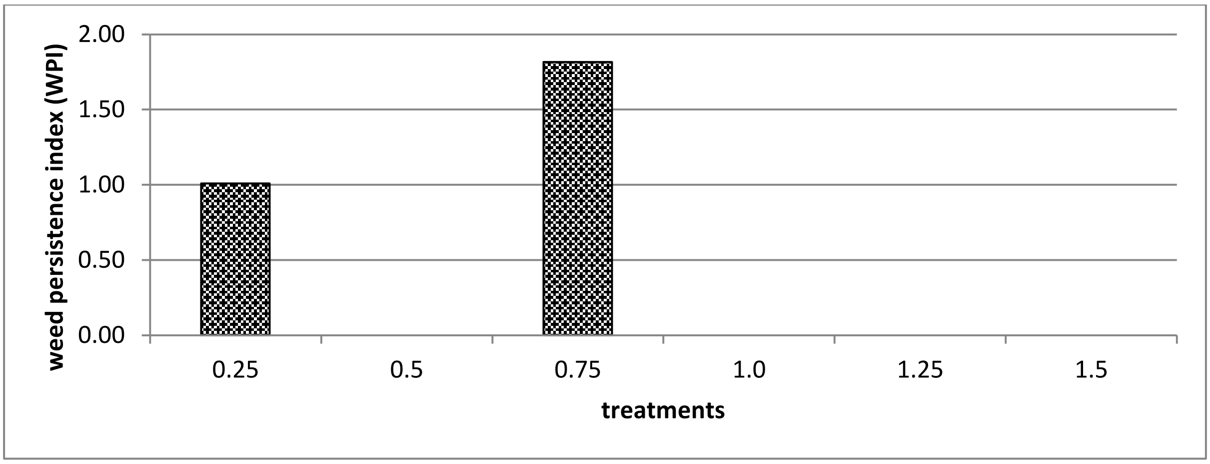

Fig.7: Weed Persistence Index (WPI)

This study was carried out to determine the efficacy of Primextra Gold in controlling or eliminating weeds in melon (*Citrullus lanatus*) and to establish its melon crop safety.

1. Melon treated with 0.75kg a.i/pot had higher height than all the other treated melons but at 28 DAT, it recorded the highest height amongst the untreated and treated melon. Treatment 0.75kg a.i/pot caused over 50% weed destruction (moderate to complete destruction) at all stages.
2. The total number of weeds and dry weight of weeds reduced with increased herbicide concentration
3. The low Weed Persistence Index (WPI) and high Weed Control Efficiency (WCE %) recorded confirmed the effectiveness of Primextra Gold in controlling / reducing weeds population.

While the herbicide concentrations was able kill or control weeds up to 100% which was commendable, its effect on the melon observed through parameters such as height, number of leaves, dry weight, crop injury etc.; caused some injury to the melon.Concentrations of Primextra Gold equal to or less than 0.75kg a.i/pot require further examination to confirm its safety for use in melon. Also, further studies are required to ascertain the response of these crops to Primextra Gold treatments in different environments, at lower concentrations, seasons, and other conditions that may influence the herbicide effectiveness, plants susceptibility and so on. The results further confirm the general opinion that an injury test for applicability of a herbicide has to be conducted before its application in practice.

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