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Efficacy of petroleum spray oils in management of powdery mildew in garden pea

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Key words: Efficacy, Mineral oils, Powdery mildew, Garden pea, Disease incidence, Severity

Abstract

Garden pea (*Pisum sativum*) is an important vegetable grown in Kenya, for both domestic and export market. Its production is hindered by diseases such as powdery mildew (*Erysiphe polygoni*), mainly controlled using chemicals. There has been a food safety concernon the use of chemical pesticides to control pests such as fungal diseases. The use of alternative methods of disease control in food production has been recommended. This study aimed at evaluating the efficacy of petroleum oils in the control of powdery mildew in garden peas. The Study was conducted for two seasons at Countrywide Connections Limited between September to December 2016 and January to April 2017. A randomized complete block design with four replications was used. The treatments were; 0.3% v/v DC-Tron NR, 0.5 % v/v DC-Tron NR and 1.0 % v/v DC-Tron NR, propineb and cymoxanil (Milraz 76 WP WP 76) and distilled water (control). Data was collected on green seed yield, disease incidence and severity. The data was tested for variance using GenStat 12.1 version. Separation of means was done using the least significant difference at 5% confidence level. Results indicated that 1% mineral oil performed best in inhibiting disease incidence and severity and increasing green seed yield as compared to the other treatments. The highest disease incidence and severity was observed in the control treatment. The findings of this study showed that 1% mineral oil may be used as alternative to chemical fungicides in management of powdery mildew in garden pea production.

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Introduction

Garden pea (*Pisum sativum)* is cultivated for fresh green seeds, tender green pods, dried seeds and foliage (Duke, 1981). In Kenya the area under garden pea's production in 2014was 11,000ha valued at KSh: 1billion (HCD, 2014). The major producing counties are Nyandarua, Nakuru and Meru. The crop is largely consumed in the domestic market with some exports as mixed prepacks. The prevalence of powdery mildew and the African boll worm are major challenges in garden pea production (HCD, 2014).

Powdery mildew in garden pea is caused by an obligate fungus *Erysiphe polygoni*. They produce mycelium that grows only on the surface of the plant tissue but does not invade the tissues themselves. The symptoms of this disease include a fungal film that appears on the upper surface of the leaf surface which subsequently becomes covered by growth of white mycelia. If uncontrolled, the entire plant may be covered with the mycelia leading to a malformed plant which will yellow and senescence prematurely. The fungus can also lead to malformed pods. Severely affected crops are covered in a white mat of powdery spores and may appear to have a bluish or silvery appearance. Powdery mildew is most common on the upper side of leaves, but it also affects the underside of leaves, young shoots and stems, buds, flowers and green pods. Powdery mildew management is mainly achieved by the use of fungicides such as sulphur, Propineb + Cymoxanil and sterol biosynthesis inhibitors. However, regular and indiscriminate use of fungicides results in development of fungicide resistant strains of the pathogen and adversely affects the environment and non-target organisms. There is therefore the need for alternative methods for disease management. In the present study, experiments were carried out to explore the potential use of mineral oils to control powdery mildew as an alternative to synthetic fungicides.

Mineral oils have been used for pest control for more than 200 years (Chapman, 1967). Foliar sprays of mineral oils have been reported to control powdery on lilac and grapes (Northover and Schneider, 1996). The mode of action of plant or mineral oils may be based on preventative, pre and post-lesion curative and antisporulant activities (Northover and Schneider, 1996).The aim of this study was to evaluate the efficacy of petroleum oil in the control of powdery mildew in garden peas. The oils have the advantages of safety to the applicator, the environment and minimal effect on natural enemies.

Materials and methods

The experiment was carried out at Countrywide Connections Limited, Kenya. The farm is at an altitude of 2100m above sea level. It has a bimodal rainfall where the short rains are experienced from October to December and long rains from March to May. The temperature ranges from 6^{o}C to 32^{o}C. The soil type is luvisols, friable and supports most crops.

Plant establishment.

Garden pea was directly seeded. The plants was established in plots measuring 2m by 2m at spacing of 50cm inter-row and 8cm intra-row to make 4 rows in a plot (single rows). To raise a good crop, the plants were base dressed with farm yard manure, 8kg per plot and Diammonium phosphate fertilizer, 0.1kg per plot. Top dressing was done after 3 weeks of crop establishment with C.A.N at a rate of 0.06 kg/plot.

The experiment was conducted under natural infection condition. (Where infection did not occur within 6 weeks after planting inoculation was carried out).

The experiment was carried out for two seasons where the first trial was conducted from September to December 2016 and the second trial from January to April 2017.

Experimental design and treatments

The experiment was laid out in a randomized complete block design (RCBD) with four replications. Each block was separated by a distance of 0.5m while plots were separated by a path of 0.5m. Each block had a measurement of 2m by 2m. The mini-plots measured 1.0m by 0.5m.

Total plants per block were 92 and total plants per mini-plot were 24. Treatments included; propineb + cymoxanil at 50g/l, three concentration levels of mineral oil; 0.3% (v/v); 0.5% (v/v) and 1.0% (v/v) and a control. Application of fungicide and mineral oil to the plants was done using a hand sprayer. Treatment application was done after every seven days.

Assessment of disease incidence and severity

Disease incidence and severity was assessed just before treatment application (base data) and thereafter, after every three days based on a standard scoring scale as described by Anon (1995).

The scale has six levels as shown in Table 1.

Table 1. Disease incidence and severity scoring scale.

Level	Damage
1	Leaf and pods free from infection
2	1-5 leaves infected
3	6-20% leaves infected
4	21-40 % leaves and pods infected
5	41-70% leaves and pods infected
6	Greater than 71% leaves and pods infected

Source: Anon, 1995.

Assessment of yield parameter

Yield measurement was done at the end of the experiment.

This was done by harvesting the pods of 10 randomly selected plants within the each plot. The mature green seeds were removed from the pods and their weight measured using a weighing balance.

Data collection and statistical analysis

Data collected on damage score and green seed yield was subjected to analysis of variance (ANOVA) and means separated through the Least Significant Difference (LSD) at 5% level of significance.

Table 2. Table of cost analysis.

Chemical	Units	Cost/Unit (Ksh.)	Application rate	Cost per 20 Litre Spray
Milraz 76 WP	Kilogram	1600	40g/20l	64
DC Tron	Litre	500	1%	100

Results

Effects of treatments on powdery mildew severity

On day one, the data collected had no significance difference when LSD was done at 95% confidence interval (Fig. 1).

The same results were observed for day 4, day 7 and day 10. However the LSD results placed the treatments at different ranks during the different days. For the four days of data collection all the treatments maintained the same ranks in their LSD mean results. The treatments ranked as follows; 0.3% mineral oil, 0.5% mineral oil, water, Milraz 76 WP, 1% mineral oil as,1, 2, 3, 4 and 5 respectively.

On day 14, plots treated with water and Milraz 76 WP had significantly different severity levels. There was no significant difference in severity levels between plots treated with Milraz 76 WP, 0.3% mineral oil and 0.5% mineral oil. While 0.3% mineral oil, 0.5 % mineral oil, and 1% mineral oil, were not significantly different. 1% mineral oil was significantly different from water and Milraz 76 WP (Fig. 2).

On day 17, the control (water) was significantly different from all other treatments. 0.3% mineral oil and Milraz 76 WP were not significantly different.

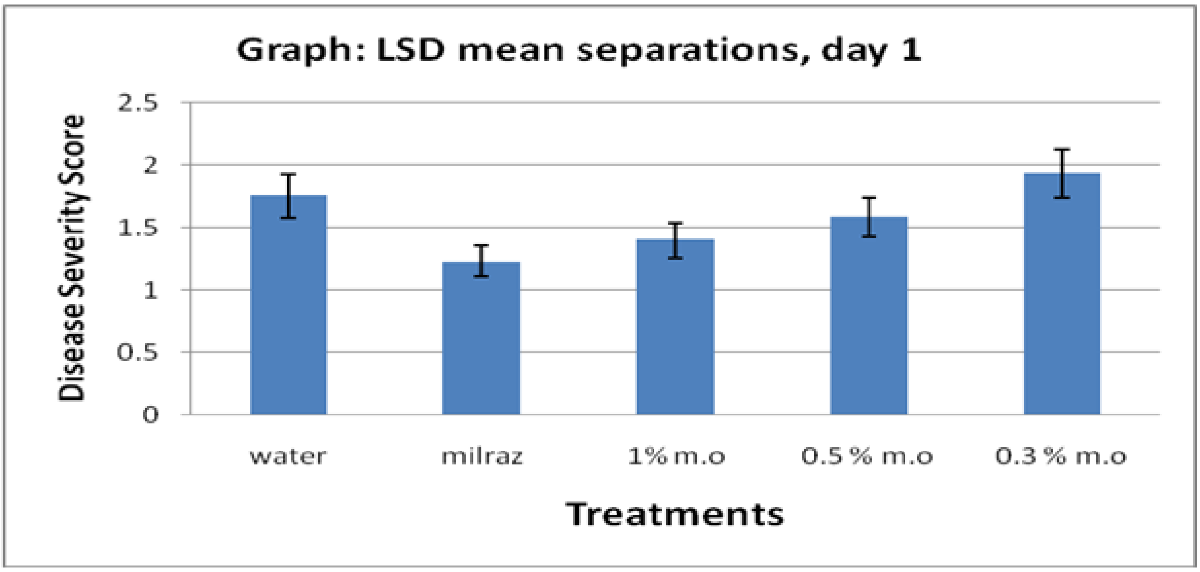

Fig. 1. LSD mean separation for disease severity at 95% confidence level as at day 1.

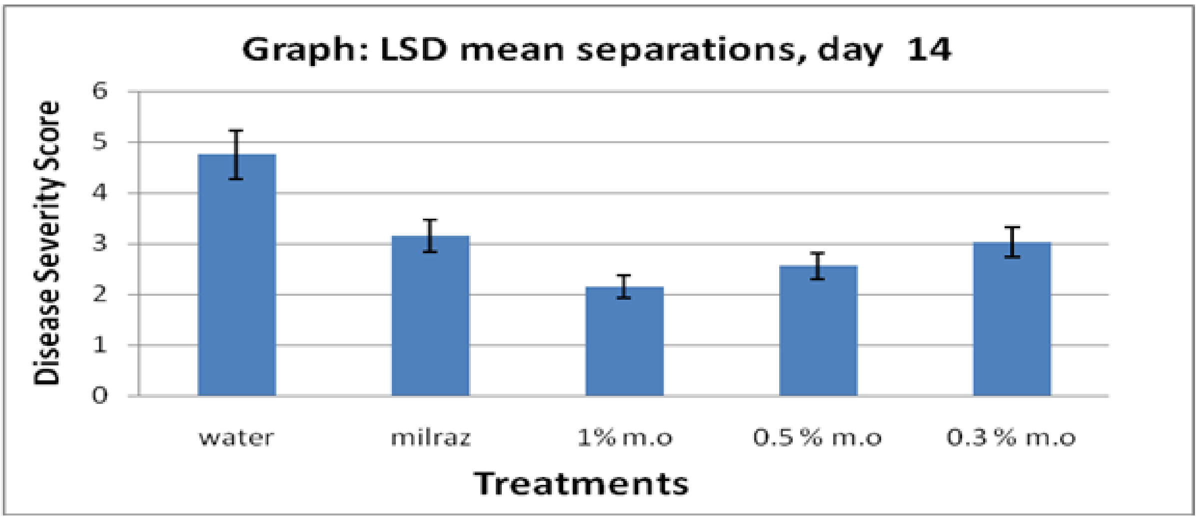

Fig. 2. LSD mean separation for disease severity at 95% confidence level as at day 14.

While 0.5 % mineral oil and 1% mineral oil were not significantly different though they were significantly different from the other treatments (Fig. 3).

On day 20, water was significantly different from all other treatments.

0.3% mineral oil and Milraz 76 WP were not significantly different. 0.5 % mineral oil and 1% mineral oil were not significantly different from each other though they were significantly different from the other treatments (Fig. 4).

On 23rd day, there was significant difference between the treatments.

The control (water) was significantly different from the other treatments. 0.3% mineral oil and Milraz 76 WP were statistically the same, mineral oil at 0.5 % and 1 % were significantly different (Fig. 5).On the 26th day (last day of data collection), water and mineral oil at 0.3 % were statistically the same while Milraz 76 WP and mineral oil at 0.5 % were statistically the same. There was no significant difference between mineral oil at 0.5 % and 1 % (Fig. 6).

Effect of treatments on green seeds yield of garden pea

The expected yield of green seeds harvested from ten plants per plot was 200 grams.

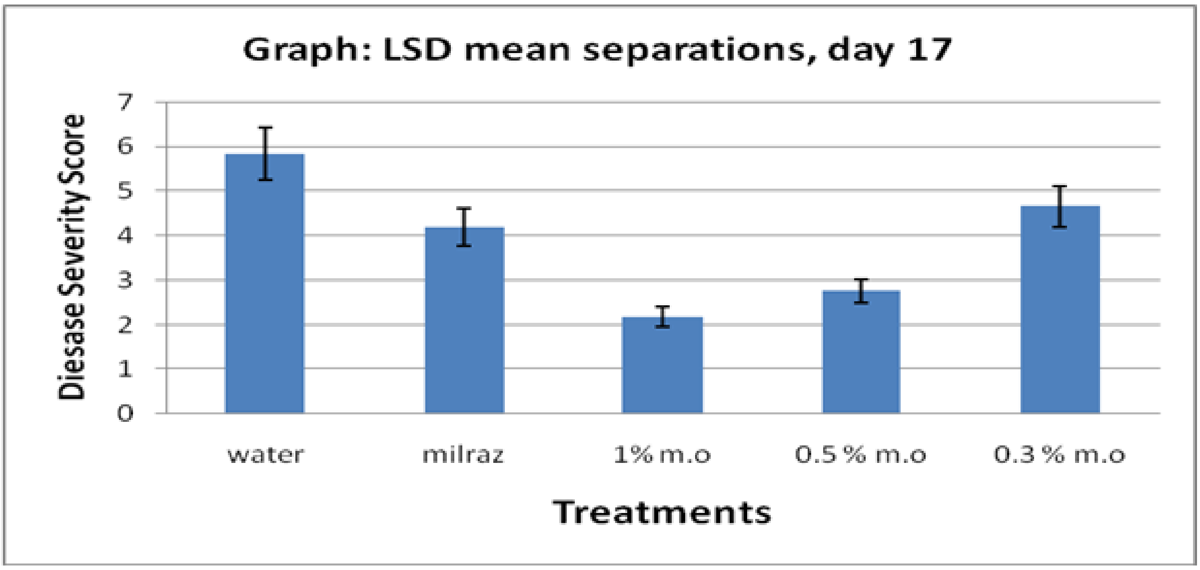

Fig. 3. LSD mean separation for disease severity at 95% confidence level as at day 17.

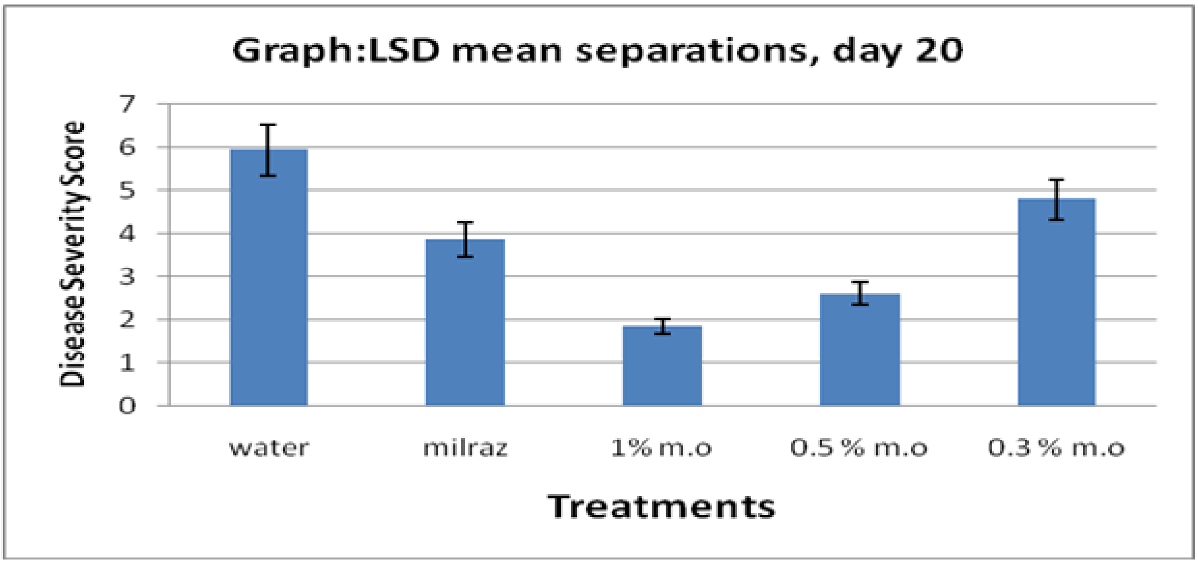

Fig. 4. LSD Mean Separation for Disease Severity at 95% Confidence Level as at Day 20.

The yield obtained from all the treatments was significantly different from each other.

The highest yield loss was observed in control (Fig. 7). Significant yield loss was also observed in plots treated with Milraz 76 WP. Among the three mineral oil treatments plots treated, 1% mineral oil exhibited the least decrease in yield, followed by 0.5% mineral and highest in 0.3% mineral oil (Fig. 8).

Discussion

From the results presented above, the first treatment application done on day 1 had no effect on the disease incidence, a gradual incidence in all the treatments was noted up to day 7 when the second treatment was done. In total four applications of the treatments were done on a seven day interval within the 26 days of assessment.

Mineral oil at 1% concentration indicated a decrease in the disease incidence and severity. Water (control) indicated a gradual increase in disease incidence and severity from the first day of data collection to the last day of data collection. In fact during the last day of data collection, the score had reached 6 which was the most damaging disease level.

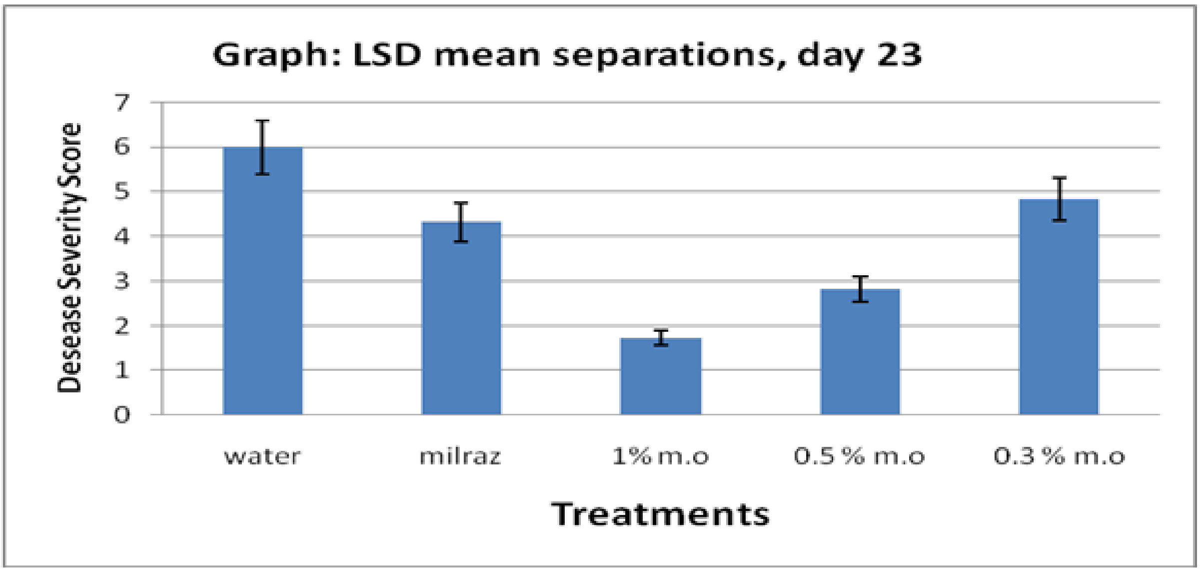

Fig. 5. LSD mean separation for disease severity at 95% confidence level as at day 23.

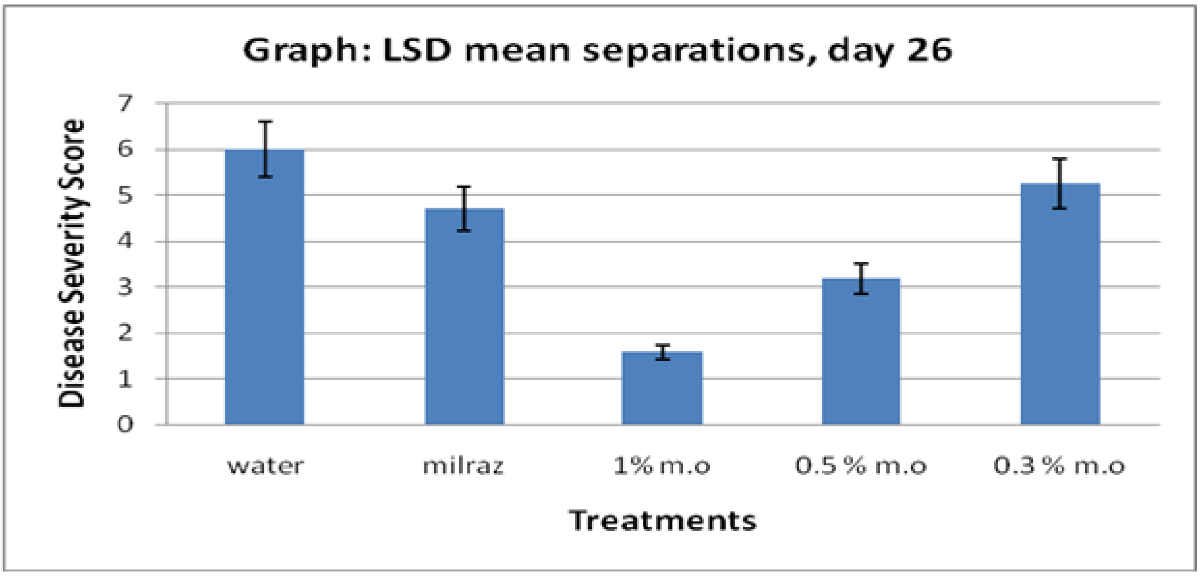

Fig. 6. LSD mean separation for disease severity at 95% confidence level as at day 26.

On the 26th day, 1% mineral oil exhibited the least disease incidence and severity. Mineral oil at 0.5 % also indicated significant decrease in the disease severity but not as effective as 1% mineral oil. In plots treated with Milraz 76 WP there was a gradual decrease in disease severity three days after every spray, but there after there was an increase in the disease incidence and severity. This observation could possibly be explained by the prolonged spray interval of 7 days. Possibly, two applications within a seven day interval would achieve better results. Analysis of variance done on the last day indicated that 1% mineral oil and 0.5% mineral oil were not significantly different at 95% confidence level.

In plots treated with 0.3% mineral oil there was a constant increase in disease severity during the 26th day period. Therefore, 0.3% mineral oil did not achieve adequate disease control potential.

The findings of this study are in agreement with Nicetic *et al.* (2002) on control of tomato and rose powdery mildew who reported that mineral oil at 0.5% and 1% concentrations were most effective against powdery mildew disease as compared to other treatments.

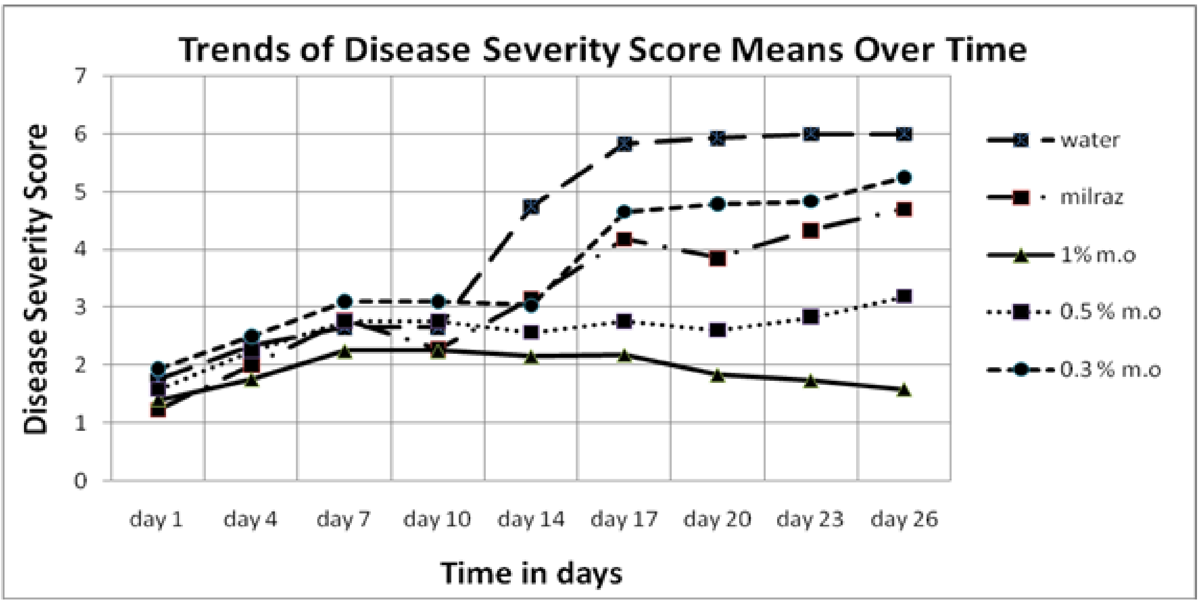

Fig. 7. Trends of Disease Severity Score in a period of 26 days.

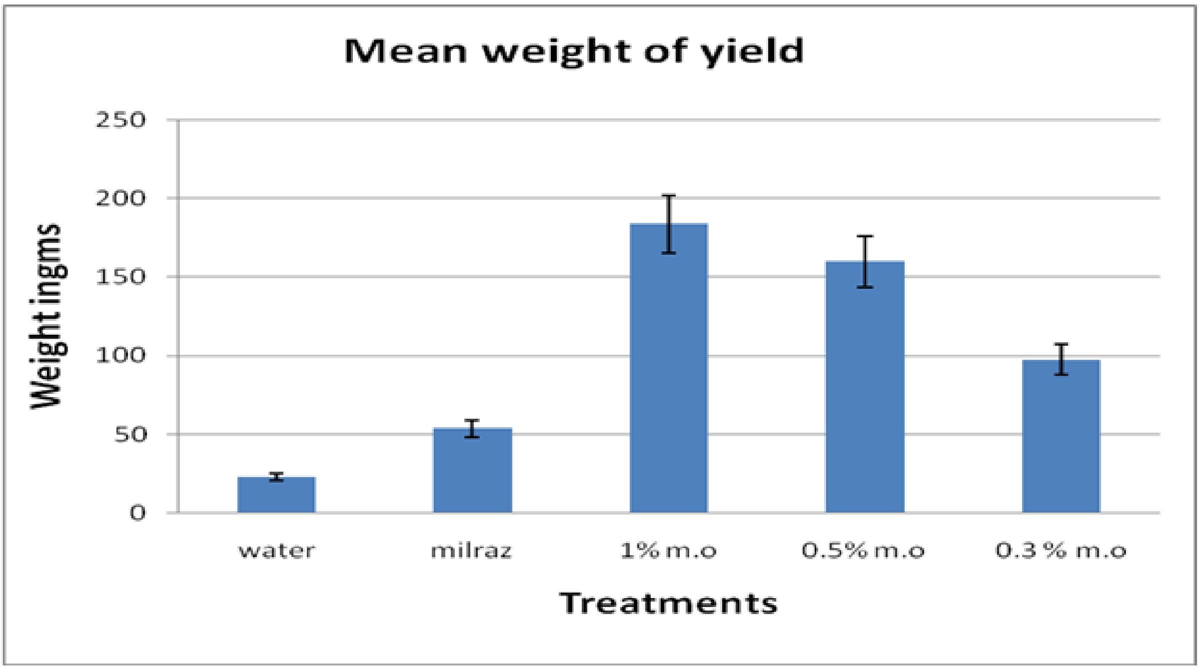

Fig. 8. Mean of green seeds yield from 10 plants per plot.

Cost analysis

The severity of powdery mildew was maintained at low score values of between 2.75 and 1.58 with four sprays of mineral oil at the rate of 1% sprayed at a seven days interval. However, four sprays of Milraz 76 WP (40g/20L) applied at the same interval exhibited fluctuating but increasing severity up to a score of 4.7. Therefore, more sprays of Milraz 76 WP would be required to keep the powdery mildew at low severity levels. This means that if two sprays of Milraz 76 WP were to be applied within seven days, they would cost approximately KSh.128 whereas one spray of 1% mineral oil would cost KSh. 100 (Table 1).

Conclusion

Mineral oil at the rates of 0.5% and 1% was found to be effective in management of powdery mildew of garden pea (*Erysiphe polygoni*).

Mineral oil at the rate of 0.3% was found to be ineffective in the control. All the three rates of powdery mildew (0.3%, 0.5%, and 1%) were found to have no phototoxic effect on garden pea.

The best control of powdery mildew in garden peas using mineral oil can be achieved if application is done at the least level of disease incidence. Therefore application of mineral oil spray should be based on regular crops scouting reports. From the standpoint of this research we recommend application of mineral oil at the rates of 0.5% and 1% depending on the disease severity; where 0.5% can be efficiently used to manage low incidence while 1% can be used to manage high incidence of powdery mildew in garden peas. A cost analysis showed that oil sprays at the rate of 1% per 20 litres reduced the cost of disease control by kshs. 28 per 7 days spray interval.

Further research is recommended to test the efficacy of the oils in management of powdery mildew in other crops.

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