INTEGRATION OF WEED MANAGEMENT PRACTICES FOR BETTER GROWTH AND YIELD OF PEA (Pisum sativumL.)

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ABSTRACT

A study was carried out to check the outcome of different weed management techniques on the growth and yield of Pea cv. Meteor at Vegetable Research Area, Department of Horticulture, Faculty of Agriculture, Dera Ismail Khan, during 2012-13. The experiment was laid out in randomized complete block design with six treatments including control (weedy check), Stomp (pendimethalin) @ 2.5 L ha^{-1}, Dual gold (S-metolachlor) @ 2.5 L ha^{-1}, threehand weeding (20, 40 and 60 DAS), transparent plastic mulch and black plastic mulch. Each treatment was replicated three times. Data on days to germination and flowering, weed density, fresh and dry weed biomass, plant height, pods $plant^{-1}$, pod length, seeds pod^{-1}andseed yield ha^{-1}were recorded and analyzed statistically. Weed density, fresh and dry biomass of weed were significantly reduced by different weed management techniques. Whereas, all plant growth, yield and yield contributing traits were considerably improved due to weed management. Significant variations existed among different weed management strategies regarding all parameters. The maximum pod yield (5.11 t ha^{-1}) was recorded from hand weeded plots, followed by black plastic (4.84) and Dual gold (4.10 t ha^{-1}). Stomp (2.61 t ha^{-1}) and clear plastic (2.55 t ha^{-1}) were statistically at par with respect to pod yields. It was concluded from the results that highest yield of pea and effective weed control were achieved by three hand weeding followed by black plastic mulch. However, maximum value of BCR (2.33) was obtained in Dual gold followed by hand weeding (2.24), suggesting that for large scale pea production, application of Dual gold @ 2.5 L ha^{-1} was economical.

Keywords: Edible pea, Pisum sativum, weeds, herbicides, pod yield, BCR

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INTRODUCTION

Pea (Pisum sativum L.) belongs to the family Leguminosae and is one of the well-known rabi season vegetable. It is an annual herbaceous self-pollinated vegetable with a trailing, climbing or dwarf growth habit. Though being a cool season crop, frost can affects its flowering and pod development (Fageria et al., 2001).Higher temperature contributes a lot for poor pod setting and reduction in seed yield. In contrast, frost adversely affected pods and flowers of pea. Pea also ranks third amongst pulse crops in Pakistan (Aslam et al., 2000; Kazmi et al., 2002).During 2011-12, an area of 56,200 ha was under pea cultivation with a total production of 36,900 tonnes in Pakistan, whereas Khyber Pakhtunkhwa shared a production of 800 tons with an average of 667 kgha^{-1}, which is the least production of pea as compared to other provinces (Anonymous, 2012). Pea crop has a wider adaptability under agro ecological conditions of Pakistan; hence, it is being cultivated in plains in winter while highlands cultivation is done in summer (Nazir et al., 1994).In comparison to many advanced countries, yield of pea in Pakistan is lower due to various reasons. To fulfill the national food requirements, the Pakistan government has to import pulses (Aslam et al., 2000). Amongst different constraints like limited and unbalanced use of fertilizer, use of old varieties, drought, fluctuating weather, the pea productivity is severely affected. There are many constraints which are responsible for lower pea yield such as non-availability of promising varieties, unbalanced use of fertilizers, water stress, but weed infestation is also an important constraint in productivity of pea (Ullahet al., 2008).Weeds are unwanted plants that grow to use the nutrients, moisture, space etc. that are needed for crop plants, hence resulting in lower yield and poor quality (Jilani et al., 2003).Weed competition in peas can result in significant yield losses. The farming community ignores weed control measures and usually concentrates on other cultivation practices (Ullah et al., 2008). Peas are sensitive to weeds at its initial growth period and thus can be used as intercrop with wheat (Khan et al. 2013). To enhance pea production and quality, implementation of prerequisite weed control measures are indispensible. Gurcharan et al., (1994) reported that application of herbicides significantly increase pea yield (79.6-85.1%). Sajid et al. (2012) found that application of pre-emergence herbicides effectively decreased weed density and resulted in higher pod yield. Muhammad et al. (2011) conveyed that hand weeding three times in a crop period effectively controlled weed density up to 96.22% in gram. Singh and Wright (2002) explained that excessive dosage of herbicide had hostile effect on growth of shoot, root extension and nodule formation.Mulching is also another important and effective cultural method to control weeds. Mulches play a very important role in controlling weed seedlings as they suppress them very effectively at the crop establishment phase. Bakhtet al., (2009) suggested the use of newspaper and black mulch, which are effective weed control tools. Keeping in view the ill effects of weeds on pea, this study was designed to check impact of different techniques for controlling weeds in infested area in pea crop.

MATERIALS AND METHODS

A research trail was conducted to assess the effect of different weed management techniques to control different weeds in pea at Horticulture Research Area, Faculty of Agriculture, Gomal University, Dera Ismail Khan, Khyber Pakhtukhwa, Pakistan, during winter season 2012-13. The experiment was conducted using randomized complete block design (RCBD) with three replications. The experimental treatments comprised of control (weedy check), Stomp @ 2.5 L ha^{-1} (pendimethaline), Dual Gold @ 2.5 L ha^{-1} (S-metolachlor), three hand weeding (20, 40 and 60 days after sowing), transparent plastic(as mulch) and black plastic (as mulch).

Prior to seed sowing, the seeds (cv. Meteor) were soaked in water for 24 hours. Land preparation was performed by using different tillage implements and calculated amount of herbicides Dual Gold and Stomp were applied in their respective plots at sowing. The recommended doses of NPK (40:90:90 kg ha^{-1})were applied in each plot in the form of Urea, Single Super Phosphate (SSP) and Muriate of Potash (MOP).The phosphorous and potassium were applied at sowing while nitrogen fertilizer was incorporated after one month of sowing. Plastic (black and transparent) were used in required plots. In three weeding treatment, weeding was done at 20, 40 and 60 days after seed sowing along with weedy check (no weeding throughout crop period). Sowing was done in October 2012 on ridges which were one meter apart and there were three ridges per plot, plant to plant distance of one foot was kept. Different parameters including days to germination and flowering, weed density, fresh and dry weed biomass (g) at time of first picking, plant height (cm), pods $plant^{-1}$, pod length (cm), seeds pod^{-1},seed yield (tha^{-1}) and benefit cost ratio (BCR) were studied during the experiment.

Statistical Analysis

The data recorded during experiment was subjected to Analysis of Variance Technique (Steel et al., 1997), while Tukey's HSD Test was used to test differences between treatment means. The statistical software package Statistix-8.1 was used for data analysis.

RESULTS AND DISCUSSION

Days to Germination

Data shown in Fig.1 revealed that different weed control measures did not affect days taken to pea seed germination. However, numerically the earliest germination was observed in control plots (5.67 days) whereas as the plots with black plastic took maximum days to germination (7.33). Contradictory to our results Sajid et al. (2012) and Khan et al. (2003) reported high germination percentage in control followed by stomp and Dual gold treated plots.

Days to flowering

The data shown in Fig.2 clearly depicted that more days to flowering (72.33) were observed in plots covered with black plastic that differed significantly from all other treatments except Stomp which was significantly at par to Dual gold with 71.0 and 69.33 days to flowering, respectively. The plants grown in control plots took the least time for flowering (66.33 days) which was statistically similar to three hand weeded and clear plastic covered plots with 67.00 and 68.00 days to flowering, respectively. These findings are supported by Bakht et al. (2009) and Jilani et al. (2016) who noted 50 % flowering delay by applying mulches. In addition, Ekinci and Dursun (2009) observed early flowering in clear plastic in contrast to black plastic mulches. While Khan et al. (2003) reported late flowering in herbicide treated plots.

Weed Density (m^{-2})

The experimental site was infested with a number of broad leaf weeds including Fumeria indica, Chenopodium album, Coronopus didymus and Vicia sativa. The data in Fig.3 clearly showed a significant effect of different weed management techniques on weed density in pea field. Maximum weed density (100 weeds m^{-2}) was recorded in control plots, which differed significantly from all other treatments. It was followed by clear plastic, Dual gold and Stomp with 80, 78 and 70 $weedsm^{-2}$, respectively. All these three treatments gave statistically similar results for weed density. Statistically, least weed density (45 m^{-2}) was reported in black plastic mulch plots which were also statistically similar to hand weeded plot, which produced 50 weeds m^{-2}. The results showed that all weed management techniques had considerably reduced the weed density as compared to the control. Least weed count in black mulches and hand weeding might be due to the presence of unsuitable growing conditions for weeds and their regular suppression in the experimental field. Our results are supported by previous work done by Bakht et al. (2009) and Jilani et al. (2016)

who also reported a remarkable reduction in weed density when hand weeding and mulches were used as weed control measures.

Fresh Weed Biomass (g m^{-2})

Data showed that highest fresh weed biomass (103.21 gm^{-2})was recorded in control (Fig.4)that varied significantly from all other treatments. It was followed by clear plastic mulch with 87.56 g m^{-2} fresh weed biomass. Stomp and Dual gold recorded statistically similar fresh weed biomass (76.62 and 70.50 g m^{-2}), respectively. Whereas, lowest fresh weed biomass was observed in black plastic mulch and hand weeded plots with 35.72 and 41.62 g m^{-2}, respectively and both the treatments showed non-significant difference against each other. Similar findings were also reported by Greer and Dole (2003), Ngouajio et al. (2008), Bakht et al. (2009), Rajablariani et al. (2012) who found that mulching was effective in preventing weeds growth while black plastic mulch was most effect in comparison to transparent mulch. Hand weeding surpassed all weed control methods due to better availability of moisture, light and space and these results were endorsed by Muhammad et al., (2011) and Jilaniet al., (2016) who found maximum weed control through hand weeding treatment.

Dry Weed Biomass (g m^{-2})

Various weed control techniques had significant effect on dry weed biomass. Similar pattern of result was found for dry weed biomass. The significantly highest dry weed biomass (14.39 gm^{-2}) was taken in checked plots followed by clear plastic mulch which yielded 13.13 gm^{-2}dry weed biomass (Fig.5). The lowest dry weed biomass was found in black plastic mulch (3.36) and three hand weeding (4.24 gm^{-2}) treatments and both treatments were similar. The application of Dual gold and Stomp yielded 10.58 and 11.53 gm^{-2} dry weed biomasses, accordingly and both the treatments are statically alike to each other. The results implied that black plastic and hand weeding proved more efficient in reducing dry weed biomass, followed by Dual gold and Stomp. These outcomes are truly corroborated by the previous work done by Greer and Dole (2003), Ngouajio et al. (2008), Bakht et al. (2009) and Rajablariani et al. (2012) who hold strong evidence of mulches in suppressing weeds population. Similarly, Qasem (2006), Zubair et al. (2009) and Jilani et al. (2016) also reported lowest dry weed biomass by the application of herbicides and hand weeding techniques.

Plant Height (cm)

Different weed control measures had significant effect on pea plant height. Taller plants (95.56 cm) were observed in plots receiving three hand weeding followed by control and clear plastic mulch with 94.48 and 92.85 cm tall plants, correspondingly and these three treatments were statistically similar to each other (Fig.6). Black plastic mulch and Dual gold treated plots gave 89.60 cm and 89.40 cm tall plants accordingly and both treatments were similar. The short stature (65.66 cm) plants were observed in Stomp amended plots. Due to suitable environmental conditions and timely uprooting of weeds by hand weeding resulted in taller plants. However, tall plants of control plots were thin, week and leggy due to weed competition for space, light and nutrients. Similarly, Jilaniet al., (2016) also reported taller plants in three hand weeding plots followed by black and transparent plastic. These results were also confirmed by Greer and Dole (2003), Bakht et al. (2009), Firoz et al. (2009) and Rajablariani et al. (2012)whose results depicted that mulches were effective in disturbing weeds growth and increasing crop growth attributes.

Pods $plant^{-1}$

Final crop yield is very much dependent upon pods $plant^{-1}$. Significantly maximum pods (30.30$plant^{-1}$) were found in plots receiving three hand weeding followed by black plastic mulch and Dual gold with 25.61 and 22.91pods $plant^{-1}$. However, all three treatments differed significantly from each other. Dual gold in turn was statistically at par with Stomp, which produced 25.61 pods $plant^{-1}$; it was succeeded by clear plastic mulch by possessing 17.25 pods $plant^{-1}$

(Fig.7).However, weedy check produced statistically lowest(9.91) pods plant^{-1}. Statistically lowest was recorded in weedy check and it might be due to the competitive nature of weeds for nutrient, space and light. The findings of trial revealed that weed management measure like mulching and herbicide use enhanced the pods per plant in comparison to weeded plants. Our results match with the findings of Muhammad et al., (2011) who also reported that higher no of pods/plant were found in hand weeding for chickpea. Increased nutrient uptake, encouraged by effective weed control at critical crop-weed competition stages might be the reason for more pods plant^{-1} in hand weeding. Similarly, Ekinci and Dursun (2009) and Firoz et al. (2009) also evidenced greater number of pods and yield by practicing different mulches to control weed problem.

Pod Length (cm)

The result shown in Fig.8 clearly depicted that pod length had significant impact on weed management. Longer pods (12.53 cm) were found in treatments receiving three weedings, trailed by black plastic mulch, Dual gold and Stomp with 11.97, 11.60 and 9.66 cm long pods, accordingly. However, there was significant difference between all treatment. Stomp gave pod length of 9.67 cm which was statistically similar to transparent plastic mulch. The small size pods (6.27 cm) were observed in weedy check. Our research output disclosed that different weed control methods were useful to increase pods length of pea. In all the treatments, three hand weeding performed better as compared to other treatments however, black plastic mulch and Dual gold were likewise effective but clear plastic mulch was least efficient. Our results were scientifically endorsed by Khan et al., (2003) and Sajid et al. (2012) who suggested chemical and plastic mulching for getting longer pods.

Seeds pod^{-1}

The weed controlling techniques showed significant variations in seeds per pods. Maximum seeds (6.08pod^{-1}) were recorded in plots receiving three hand weeding which was statistically different from remaining treatments excluding black plastic mulch with 5.40 seeds pod^{-1}. However, black plastic mulch results were at par with Dual gold having 5.02 seeds pod^{-1}, and also shown same result with Stomp and clear plastic mulch with 4.64 and 4.38 seeds pod^{-1}, respectively. The least seeds (2.93pod^{-1}) were recorded in weedy check. Data relating to the number of seeds pod^{-1}recommendedthat various weed control measures i.e. conventional, chemical and mulching significantly increased seeds pod^{-1}compared to weedy check (control). This could be due to highest availability of nutrients to plants by using hand weeding techniques for weeds control (Bidlack et al.,2006; Bakht et al., 2009).

Pod Yield (t ha^{-1})

Significant variation existed among different weed management practices including conventional, chemical and mulching regarding production of peas in t ha^{-1} as shown in Fig.10. Three hand weeding significantly produced the highest pod yield (5.12 t ha^{-1}) succeeded by black plastic mulch and Dual gold application with 4.84and 4.11 t ha^{-1}and both the treatments differed statistically from one another. Likewise, Stomp application and clear plastic mulch yielded similar pod yield of 2.62 and 2.52 t ha^{-1}, accordingly. The least pod yield (1.09 t ha^{-1}) was obtained from weedy check. The results suggested that weed management strategies significantly enhanced the pea pod yield. Various scientists experimenting on different crops like Khan et al. (2003), Sajid et al. (2012) and Ansar et al. (2010) also observed maximum yield and production by using different controlling strategies. Furthermore, Greer and Dole (2003), Firoz et al. (2009), Rajablariani et al. (2012), Bakht et al. (2009), Ekinci and Dursun (2009) have taken higher crop yield by adopting the use of plastic mulches, however, bumper crop yield was ensured by treatments where hand weeding was applied but its economic viability and availability of skilled labors are two main constraints.

Benefit Cost Ratio

The computation of economic analysis indicated that maximum income (Rs.153,375/) as well as maximum net return (Rs. 84,975/-) were obtained from three hand weeding. It was proceeded by black plastic mulch with Rs.145,323/ and Rs.79,923/ income and net return, respectively (Fig.11). The highest Benefit Cost Ratio (BCR) of 2.33 was recorded in Dual gold application, which was succeeded by three hand weeding with BCR of 2.24, suggesting that application of Dual gold @ 2.5 L ha^{-1} was the most economically and financially feasible treatment for weed management in pea.

CONCLUSIONS

The findings of the experiment revealed all the measures adopted for weed control whether cultural or chemical had significant influence on weed density, growth of plant, yield and yield contributing parameters of pea. Weeds density was significantly reduced while all plant growth and yield parameters were considerably increased. The superior results were expressed by manual weed control method followed by black plastic mulch. Dual gold and Stomp also enhanced yield and decreased weeds density effectively while clear plastic was least effective. However, the BCR indicated that application of Dual gold was most economically feasible practice. Although the highest total and net income were achieved from hand weeding, followed by black plastic mulch and Dual gold but use of Dual gold @ 2.5 L ha^{-1} is suggested for economical production of pea.

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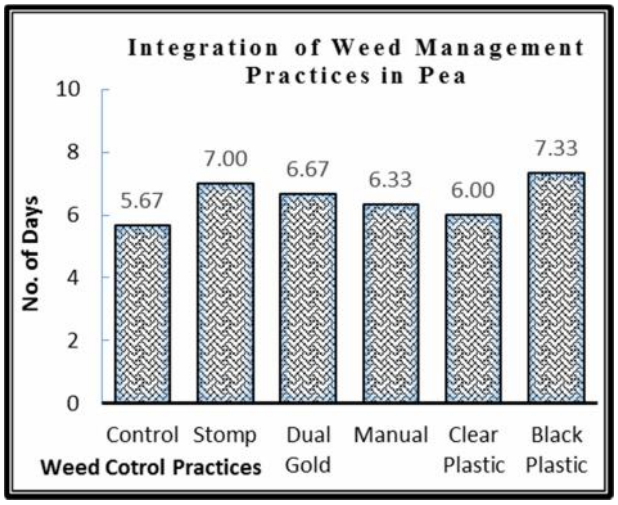


Fig.1 Number of days to germination

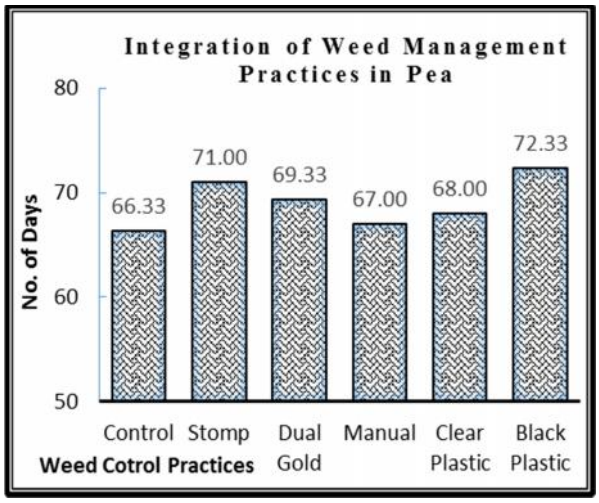


Fig.2 Number of days to flowering

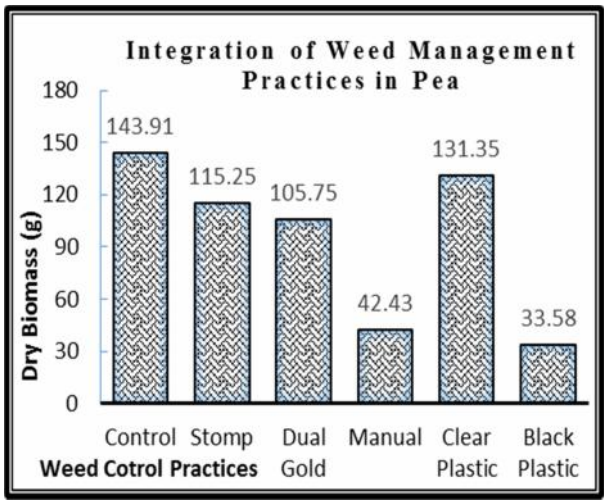


Fig.3 Weed density (m^{-2})

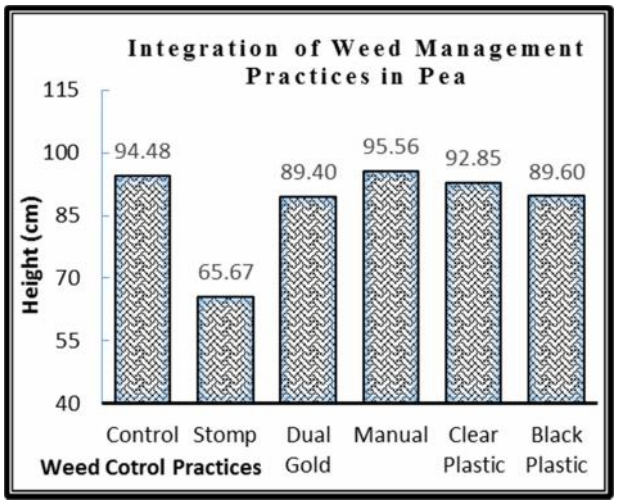
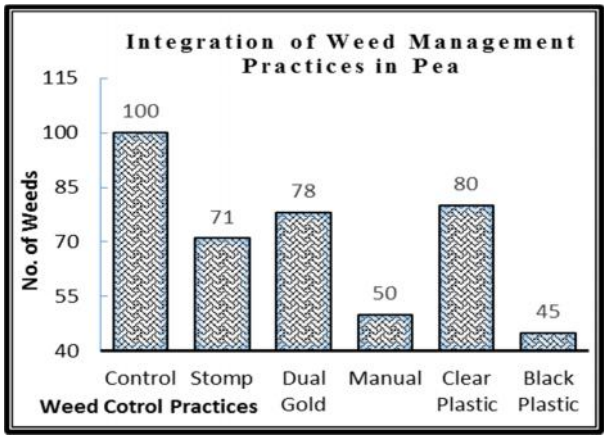


Fig.4 Fresh weed biomass (gm^{-2})



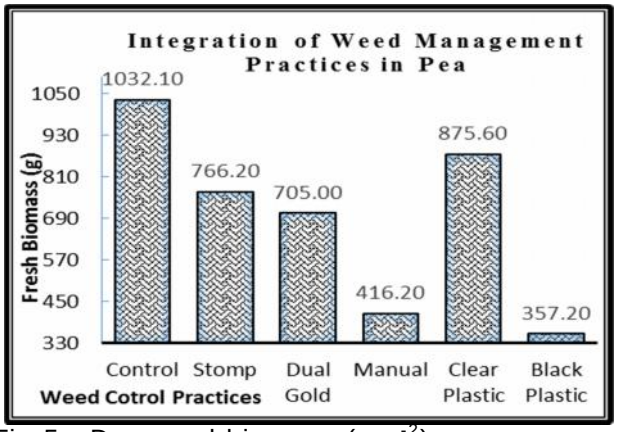


Fig.5 Dry weed biomass (gm^{-2})

Fig.6 plant height (cm)

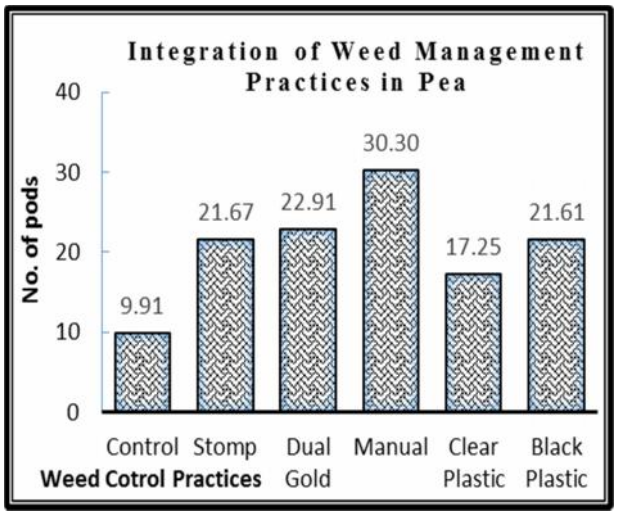


Fig.7 Number of pods (plant^{-1})

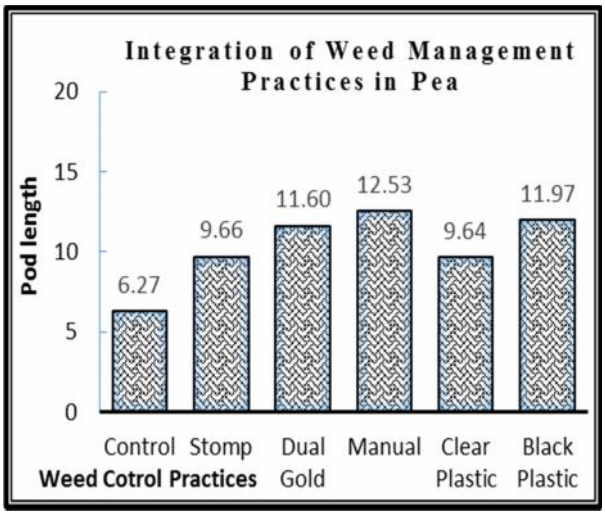


Fig.8 Pod length (cm)

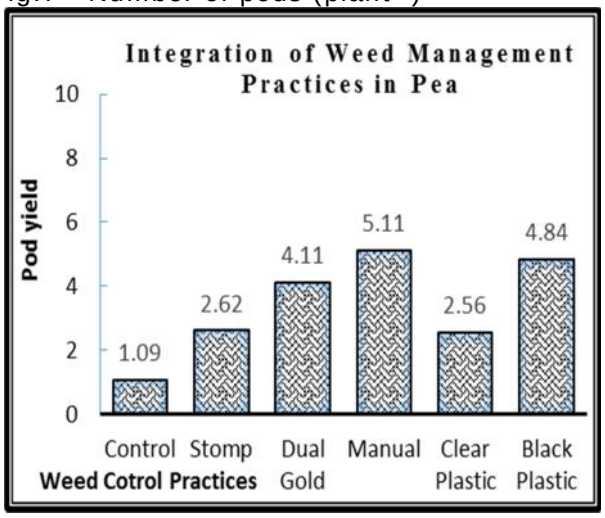


Fig.9 Number of seeds (pod^{-1})

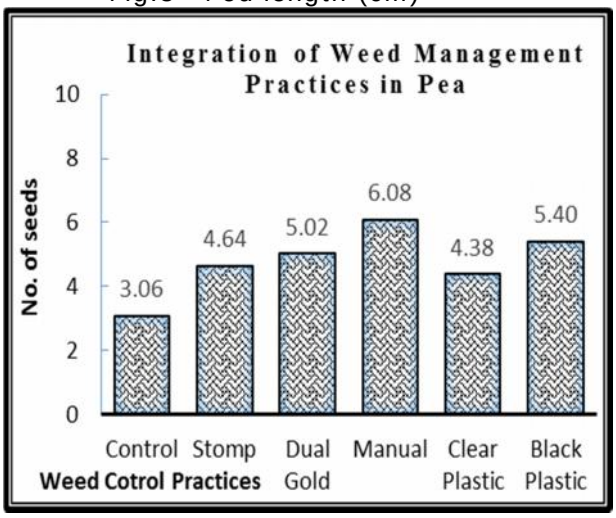


Fig.10 Pod yield (t ha^{-1})

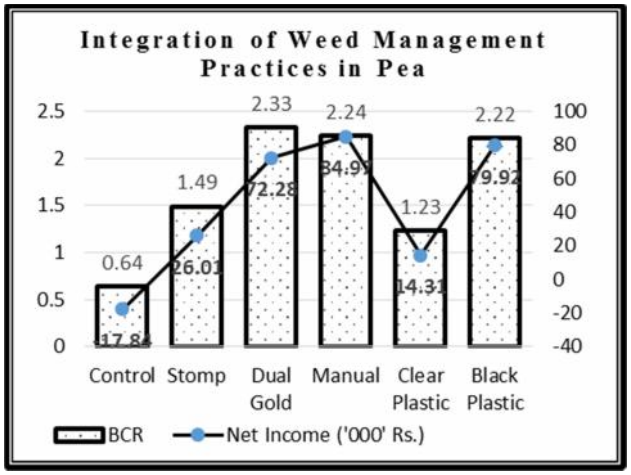


Fig.11 BCR with Net income