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INTEGRATED WEED MANAGEMENT STRATEGIES FOR ENHANCING GROWTH AND YIELD OF POTATO (*SOLANUM TUBEROSUM* L.) IN THE GIRD REGION OF MADHYA PRADESH INDIA

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ABSTRACT

Potato (*Solanum tuberosum* L.) is the fourth most important food crop worldwide, but its productivity is often limited by severe weed infestation, particularly in regions like Madhya Pradesh where yield levels are below the national average. Due to the slow initial growth of potato, weeds gain a competitive advantage, reducing yield by 10–80% through competition for nutrients, water, and light, and by serving as alternate hosts for pests and diseases. Manual weeding, though effective, is costly, labour-intensive, and often impractical during peak farm operations, highlighting the need for integrated and chemical weed management strategies. To address this problem, a field experiment entitled "Integrated weed management strategies for enhancing growth and yield of potato (*Solanum tuberosum* L.) in the Gird region of Madhya Pradesh" was conducted during the rabi season of 2024–25 at the Crop Research Center, School of Agriculture. The study evaluated the efficacy of different pre- and post-emergence herbicides, either alone or in combination, on weed suppression, crop growth, yield attributes, tuber quality, and economics, along with assessing any phytotoxicity effects. The major weed flora observed included broadleaf species such as *Chenopodium album* and *Anagallis arvensis*, and grassy weeds like *Avena ludoviciana* and *Digitaria sanguinalis*. The results revealed that herbicidal treatments provided significant reduction in weed density and dry weight compared to manual weeding alone, thereby improving tuber yield and quality. Among the treatments, metribuzin and other selective herbicides showed promising efficacy, particularly when applied at appropriate doses and timings, without causing severe phytotoxic effects on the crop. Economic analysis further demonstrated that herbicide use reduced weeding costs by up to 75–85% compared to manual methods, while ensuring higher net returns due to improved yields. In conclusion, the integration of effective pre- and post-emergence herbicides in potato cultivation not only offers timely and economical weed management but also ensures sustainable yield enhancement, making it a viable strategy to meet the growing demand for potatoes in India.

***Keywords*:** Potato, Integrated weed management, Herbicides, Metribuzin, Weed flora, Tuber yield, Phytotoxicity, Economics.

Introduction

Potato (*Solanum tuberosum* L.) is the fourth most important food crop in the world after rice, wheat, and maize, contributing significantly to global food and nutritional security. In India, potato occupies about 2.3 million hectares with an annual production of 55 million tons, but the productivity in several regions such as Madhya Pradesh remains below the national average. Among the major constraints in potato production, weed infestation is particularly critical due to the crop's slow initial growth and poor competitive ability against weeds. Uncontrolled weeds reduce yield by 10–80% depending on the severity and duration of competition, while also lowering tuber quality and interfering with harvest operations.

Although manual weeding and cultural practices are traditionally used, these approaches are labour-intensive, costly, and often untimely during peak operations. Earlier studies have demonstrated that herbicides such as fluchloralin, pendimethalin, alachlor, isoproturon, paraquat, and particularly metribuzin, are effective for weed management in potato when applied at appropriate stages (Bhalla *et al*., 1980; Lal and Gupta, 1984; Gopinath and Mina, 2009). Metribuzin, a triazinone herbicide, has been widely reported for its bio-efficacy against broad-spectrum weeds, though its phytotoxicity on sensitive cultivars and misapplication remains a concern (Barbas & Sawicka, 2020). Recent advancements in weed control suggest that integrating selective pre- and post-emergence herbicides with cultural methods can reduce weeding costs by 75–85% while sustaining high tuber yield and quality.

Keeping these issues in view, the present investigation entitled *"Effect of Different Pre and Post Emergence Herbicides on Growth, Yield and Quality of Potato (Solanum tuberosum L.) and Associated Weeds"* was undertaken during the rabi season of 2024–25. The study aimed to identify the predominant weed flora in potato fields, evaluate the efficacy of different herbicides on weed suppression, assess their impact on crop growth and tuber yield, determine any phytotoxic effects, and analyse the economic feasibility of various treatments.

Material and Method

A field experiment was conducted at the Research Farm of the School of Agriculture, ITM University, Gwalior, Madhya Pradesh during the Rabi season of 2024–25 to evaluate the "Integrated weed management strategies for enhancing growth and yield of potato *(Solanum tuberosum* L.) in the Gird region of Madhya Pradesh". The geographical coordinates of the experimental site are 26°14' N latitude and 78°14' E longitude with an elevation of 206 meters above mean sea level. The experimental field falls in the subtropical climatic zone, characterized by hot and dry summers, humid monsoon, and cool winters.

The trial was laid out in a randomized block design with three replications and ten treatments, including various pre and post emergence herbicides and their combinations along with weed free and weedy check plots. The treatments included: T_1: Paraquat Dichloro @ 450 g a.i. ha^{-1} (EPoE), T_2: Quizalofop-p-ethyl @ 30 g a.i. ha^{-1} (PoE), T_3: Metribuzin @ 500 g a.i. ha^{-1} (PE), T_4: Pendimethalin @ 1000 g a.i. ha^{-1} (PE), T_5: Clodinafop + Metribuzin @ 200 g a.i. ha^{-1} RM (PoE), T_6: Atrazine @ 1000 g a.i. ha^{-1} (PE), T_7: Atrazine @ 1000 g a.i. ha^{-1} (PE) fb Metribuzin @ 500 g a.i. ha^{-1} (PoE), T_8: Atrazine @ 750 g a.i. ha^{-1} + Pendimethalin @ 600 g a.i. ha^{-1} (Tank mix PE), T_9: Weed-free, and T_{10}: Weedy check. The experimental area had sandy loam soil with a slightly alkaline reaction (pH 7.9), low electrical conductivity (0.28 dSm^{-1}), low organic carbon (0.41%), low available nitrogen (167.2 kg/ha), medium available phosphorus (16.2 kg/ha), and high available potassium (372 kg/ha). The average maximum and minimum temperatures during the crop season ranged between 35°C and 8°C, respectively, while relative humidity fluctuated between 40% and 90% across different months.

Most popular variety of potato of this region 'Kufri Pukhraj', an early maturing and high-yielding potato variety, were planted at a spacing of 70 cm × 10 cm with a uniform seed rate of 2.8 t/ha. Recommended doses of fertilizers (180:90:100 kg/ha of N, P_2O_5, and K_2O) were applied, with nitrogen supplied in split doses at planting and earthing-up stages. The other recommended crop management practices, including irrigation, plant protection, and harvesting, were uniformly followed across all treatment plots.

The herbicides were applied using a knapsack sprayer with a flat-fan nozzle and a spray volume of 800 litres per hectare. Observations on weed density, dry matter, weed index, and weed control efficiency were recorded at different intervals using standard quadrat sampling methods. The crop's growth, yield attributes, tuber yield, biological yield, harvest index, and quality parameters such as dry matter and starch content were assessed, while phytotoxicity symptoms were evaluated using standard rating scales. The collected data were statistically analyzed through ANOVA and compared using the critical difference (CD) at 5% significance level using the agrianalyze tool.

This study aims to generate practical recommendations for integrating chemical weed control methods into potato cultivation in the agro-climatic conditions of central India, thereby enhancing productivity, reducing labour costs, and improving profitability for farmers.

Result and Discussion

The influence of different pre and post-emergence herbicide treatments on the growth parameters of potato (*Solanum tuberosum* L.) is summarized in Table 1. The results indicate significant differences among treatments for all measured traits plant height, number of branches per hill, number of haulms per hill, fresh weight of haulms per hill, and dry weight of haulms

per hill at 5% level of significance. The observed variability highlights the effectiveness of weed management practices in enhancing crop growth under field conditions.

Plant Height

The maximum plant height (79.07 cm) was recorded in the weed-free treatment (T9), closely followed by Atrazine fb Metribuzin at 72.27 cm. The lowest height (41.03 cm) was recorded in the weedy check (T10), where weeds severely competed with the potato crop for nutrients, water, and sunlight. These findings are consistent with the earlier studies by Lal and Gupta (1984), who reported that unchecked weed infestation could reduce plant height and vegetative growth in potato by limiting resource availability.

Number of Branches per Hill

The weed-free plot showed the highest number of branches per hill (59.51), while Atrazine fb Metribuzin treatment (T7) also performed well with 55.64 branches. The weedy check recorded the lowest value of 36.96. Enhanced branching under effective weed control treatments may be attributed to uninterrupted availability of nutrients and light, allowing the crop to invest more in vegetative propagation.

Number of Haulms per Hill

A similar trend was observed for haulm production. The weed-free treatment exhibited superior performance with 11.03 haulms per hill, followed by Atrazine fb Metribuzin (9.80 haulms). The weedy check showed a marked reduction to only 3.91 haulms per hill. Weed interference has been reported to restrict stolon development and haulm expansion (Singh *et al.*, 1984), supporting the observations in this experiment.

Fresh and Dry Weight of Haulms

The weed-free treatment recorded the highest haulm fresh weight (215.73 g) and dry weight (38.90 g), whereas the weedy check had the lowest values (101.53 g and 24.16 g, respectively). Among herbicidal treatments, Atrazine fb Metribuzin (197.45 g fresh and 36.37 g dry) was the most effective, demonstrating that timely weed control supports biomass accumulation. These results corroborate the findings of Gopinath and Mina (2009), who reported that herbicide-based weed management improved plant growth parameters and reduced yield losses by 75–85% compared to manual methods.

The results clearly demonstrate that weed competition negatively affects potato growth, while appropriate weed management practices can significantly enhance crop development. Among the herbicidal treatments, Atrazine fb Metribuzin proved most efficient in promoting plant height, branching, haulm number, and biomass accumulation, likely due to better weed suppression during critical growth stages. This finding aligns with earlier reports (Bhalla *et al.*, 1980; Barbas & Sawicka, 2020) that metribuzin-based combinations are effective in providing weed-free conditions without causing severe phytotoxic effects when applied judiciously.

Although manual weeding (weed-free treatment) produced the highest growth parameters, it is labour-intensive and economically challenging, especially in peak seasons. Therefore, the use of herbicides such as Atrazine fb Metribuzin offers a practical and efficient alternative for integrated weed management. However, proper dose and timing are critical to avoid crop damage and ensure sustained growth.

Table 1: Effect of different weed control treatment on growth parameters

Tr. No.	Treatments	Growth Parameters				
		Plant height (cm)	No. of branches hill^{-1}	No. of Haulms per hill	Fresh weight of haulm per hill (g)	Dry weight of haulm per hill (g)
T_1	Paraquat Dichloro at 450g a.i./ha (EPoE)	55.94	45.58	6.58	145.33	29.79
T_2	Quizalofop-p-ethyl at 30g a.i./ha (PoE)	48.14	41.12	5.16	120.24	26.88
T_3	Metribuzin at 500g a.i./ha (PE)	64.59	51.01	8.40	175.94	33.34
T_4	Pendimethalin at 1000g a.i./ha (PE)	57.01	46.14	6.86	152.10	30.16
T_5	Clodinafop + Metribuzin at 200g a.i./ha RM (PoE)	65.49	51.75	8.60	179.56	33.82
T_6	Atrazine at 1000g a.i./ha (PE)	54.93	45.08	6.35	138.55	29.46
T_7	Atrazine at 1000g a.i./ha (PE) fb Metribuzin at 500g a.i./ha (PoE)	72.27	55.64	9.80	197.45	36.37
T_8	Atrazine at 750g a.i./ha + pendimethalin at 600g a.i./ha Tank mix (PE)	63.82	50.07	8.16	170.38	32.73
T_9	Weed free	79.07	59.51	11.03	215.73	38.90
T_{10}	Weedy check	41.03	36.96	3.91	101.53	24.16
SEm±		0.09	1.29	0.40	5.97	0.84
LSD (p=0.05)		0.28	3.86	1.20	17.74	2.52

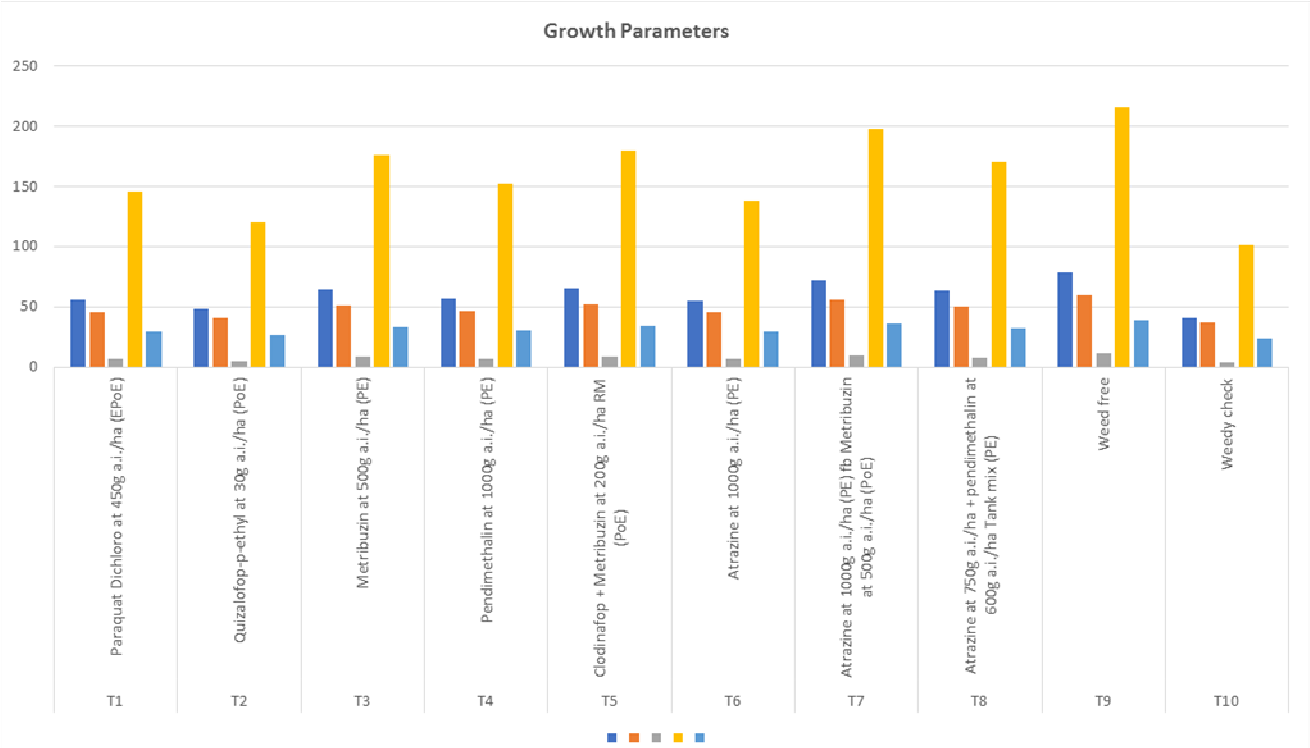

Fig. 1 : Effect of different weed control treatment on growth parameters

The effect of different pre- and post-emergence herbicide treatments on tuber number (grade-wise and total) in potato is presented in Table 2. The data reveal significant differences among treatments for the number of tubers in various size grades (A: <25 g, B: 25–100 g, C: >100 g) and the total tuber count per square meter at harvest.

Number of Tubers by Grade

GradeA(<25g):

The highest number of small-sized tubers (14.84 no. m^{-2}) was recorded in the weed-free treatment (T9), followed by Atrazine fb Metribuzin (T7) with 13.68 no. m^{-2}. The lowest value was observed in the weedy check (T10) with only 7.06 no. m^{-2}. These results indicate that weed competition adversely affects early tuber development, limiting the plant's ability to form smaller tubers, which often serve as a source for later growth and nutrient partitioning.

GradeB (25–100g):

A similar trend was observed in the medium-sized tubers, where weed-free plots yielded the highest number (44.24 no. m^{-2}), followed by Atrazine fb Metribuzin (40.50 no. m^{-2}). The weedy check recorded the lowest count of 23.28 no. m^{-2}. The reduction in medium-sized tubers in untreated plots could be attributed to reduced photosynthetic efficiency and nutrient availability due to competition from weeds (Lal and Gupta, 1984).

GradeC(>100g):

For large-sized tubers, the weed-free treatment again led with 11.28 no. m^{-2}, followed by Atrazine fb Metribuzin (10.11 no. m^{-2}). The weedy check recorded only 4.30 no. m^{-2}. The presence of larger tubers in well-managed plots is a direct reflection of favorable growth conditions, where resources are efficiently utilized for tuber bulking during later stages of crop growth.

Total Number of Tubers

The total number of tubers per square meter followed the same pattern as observed in grade-wise data. The weed-free treatment resulted in the highest total tuber count of 70.36 no. m^{-2}, while Atrazine fb Metribuzin (T7) produced 64.29 no. m^{-2}. The lowest was seen in the weedy check (34.64 no. m^{-2}), highlighting the detrimental impact of unmanaged weeds on potato tuber formation.

Discussion

The results clearly demonstrate that weed management through effective herbicide application significantly enhances tuber formation across all size categories. The superiority of weed-free and Atrazine fb Metribuzin treatments suggests that controlling

weeds during critical stages of potato growth facilitates resource allocation towards tuber development. These findings are in agreement with earlier studies where weed competition was reported to reduce tuber yield by limiting light interception and nutrient absorption (Singh *et al*., 1984; Gopinath and Mina, 2009).

Additionally, the higher number of Grade C tubers in weed-controlled plots is of particular agronomic and economic importance, as larger tubers are generally preferred in the market for both table use and processing. The use of selective herbicides such as Atrazine and Metribuzin in combination provided effective weed control without causing phytotoxic effects, which aligns with previous reports that these herbicides are safe and beneficial when applied at recommended doses (Bhalla *et al*., 1980; Barbas & Sawicka, 2020).

While manual weeding (weed-free) produced the maximum tuber count, the higher cost and labour requirements of such practices may limit their adoption. Herbicide-based management offers a practical alternative, ensuring timely weed control, better resource utilization, and improved yield, especially under conditions where labour availability is constrained.

Conclusion

The study confirms that integrating pre and post-emergence herbicides such as Atrazine fb Metribuzin can substantially improve the number of tubers in potato, particularly in the larger, market-preferred size categories. This practice can serve as a cost-effective and sustainable component of potato cultivation, supporting both yield maximization and profitability.

Tuber yield

The influence of different pre and post-emergence herbicide treatments on the grade-wise and total tuber yield of potato is presented in Table 3. Significant differences were observed among the treatments for all categories Grade A (<25 g), Grade B (25–100 g), Grade C (>100 g), and total tuber yield at 5% level of significance. The data clearly illustrate the beneficial impact of timely weed management practices on tuber production.

Grade-wise Tuber Yield

GradeA(<25g):

The highest yield of small-sized tubers was recorded in the weed-free treatment (11.95 q/ha), followed by Atrazine fb Metribuzin (10.84 q/ha), while the lowest yield was recorded in the weedy check (5.66 q/ha). The increased yield of smaller tubers under weed-free conditions suggests that early-season growth stages benefit from reduced weed competition, resulting in better tuber set and initiation.

GradeB(25–100g):

The highest yield for medium-sized tubers was observed in the weed-free treatment (141.63 q/ha), followed by Atrazine fb Metribuzin (128.53 q/ha). The lowest yield was recorded in the weedy check (67.13 q/ha). Medium-sized tubers contribute significantly to the overall marketable yield, and weed competition during critical growth phases appears to limit their development by restricting nutrient availability.

GradeC(>100g):

For large-sized tubers, weed-free treatment again outperformed other treatments with 92.01 q/ha, followed by Atrazine fb Metribuzin (83.53 q/ha). The lowest yield was in the weedy check (43.64 q/ha). The ability to produce larger tubers is crucial for market value and processing industries, highlighting the importance of weed control in optimizing crop performance during later growth stages.

Total Tuber Yield

The total tuber yield mirrored the trends observed in grade-wise data. Weed-free treatment (245.59 q/ha) led to the highest tuber yield, while Atrazine fb Metribuzin (222.89 q/ha) closely followed. The lowest total yield (116.43 q/ha) was recorded in the weedy check. This shows that weed control significantly enhances overall productivity by improving tuber formation across all grades.

Discussion

The data strongly indicate that effective weed management through herbicide application enhances tuber yield at all size grades. Weed-free treatment consistently provided the best performance, demonstrating the critical role of reducing competition during both early and later stages of tuber formation. Among herbicidal treatments, Atrazine fb Metribuzin proved highly effective, delivering results comparable to weed-free conditions, which aligns with earlier findings by Lal and Gupta (1984) and Gopinath and Mina (2009). The improved tuber yield in herbicide-treated plots can be attributed to better nutrient uptake, efficient photosynthesis, and reduced plant stress.

The marked improvement in the large-sized tuber yield (Grade C) in weed-managed plots has significant implications for profitability. Large tubers are preferred in both fresh market consumption and processing industries (chips, fries), making weed management a critical factor in achieving higher

economic returns. These results are supported by the findings of Bhalla *et al*. (1980), who observed that herbicide-based weed control positively influences tuber size distribution and yield without causing phytotoxicity when applied at recommended doses.

Although manual weeding produced the highest yields, it is labour-intensive and not always feasible for large-scale farming. Herbicide-based strategies, particularly the use of Atrazine fb Metribuzin, offer a cost-effective alternative that can reduce labour requirements while ensuring optimal tuber yield and quality.

Conclusion

The experiment confirms that weed management significantly improves tuber yield across all size grades in potato cultivation. Weed-free conditions provided the highest yields; however, the Atrazine fb Metribuzin treatment emerged as an efficient and practical solution, achieving high tuber yields comparable to manual weeding. These findings reinforce the importance of integrating chemical weed control into potato production systems to enhance productivity, ensure profitability, and meet market demand.

Table 2 : Effect of different weed control treatments on Grade wise no. of tubers of Potato

Tr.	Treatment	No of tuber (no. m^{-2}) (Grade Wise)			Total no. of tuber (no. m^{-2})
		Grade A (<25 g)	Grade B (25–100 g)	Grade C (>100 g)	
T_1	Paraquat Dichloro at 450g a.i./ha (EPoE)	9.91	31.84	7.09	48.84
T_2	Quizalofop-p-ethyl at 30g a.i./ha (EPoE)	8.17	27.32	5.51	41.00
T_3	Metribuzin at 500g a.i./ha (PE)	12.07	36.04	8.82	56.93
T_4	Pendimethalin at 1000g a.i./ha (PE)	10.65	32.12	7.38	50.15
T_5	Clodinafop + Metribuzin at 200g a.i./ha RM (PoE)	12.51	36.72	8.92	58.15
T_6	Atrazine at 1000g a.i./ha (PE)	9.33	31.08	6.68	47.09
T_7	Atrazine at 1000g a.i./ha (PE) fb Metribuzin at 500g a.i./ha (PoE)	13.68	40.5	10.11	64.29
T_8	Atrazine at 750g a.i./ha + pendimethalin at 600g a.i./ha Tank mix (PE)	11.84	35.82	8.57	56.23
T_9	Weed free	14.84	44.24	11.28	70.36
T_{10}	Weedy check	7.06	23.28	4.30	34.64
	SEm±	0.36	1.24	0.39	3.04
	LSD (*p*=0.05)	1.07	3.69	1.16	9.03

Table 3 : Effect of different weed control treatments on the grade wise tuber yield of Potato

Tr.	Treatment	Tuber yield (Grade Wise) (Q/ha)			Tuber Yield Q/ha
		Grade A (<25 g)	Grade B (25-100 g)	Grade C (>100 g)	
T_1	Paraquat Dichloro at 450g a.i./ha (EPoE)	8.02	95.12	61.83	164.98
T_2	Quizalofop-p-ethyl at 30g a.i./ha (EPoE)	6.69	79.34	51.57	137.59
T_3	Metribuzin at 500g a.i./ha (PE)	9.65	114.40	74.33	198.38
T_4	Pendimethalin at 1000g a.i./ha (PE)	8.31	98.56	64.07	170.94
T_5	Clodinafop + Metribuzin at 200g a.i./ha RM (PoE)	9.82	116.47	75.70	201.99
T_6	Atrazine at 1000g a.i./ha (PE)	7.78	92.27	59.98	160.03
T_7	Atrazine at 1000g a.i./ha (PE) fb Metribuzin at 500g a.i./ha (PoE)	10.84	128.53	83.53	222.89
T_8	Atrazine at 750g a.i./ha + pendimethalin at 600g a.i./ha Tank mix (PE)	9.36	110.98	72.12	192.45
T_9	Weed free	11.95	141.63	92.01	245.59
T_{10}	Weedy check	5.66	67.13	43.64	116.43
	SEm±	0.34	3.64	2.41	6.86
	LSD (*p*=0.05)	1.00	10.8	7.16	20.4

The impact of different pre and post-emergence herbicide treatments on tuber yield, haulms yield, biological yield, and harvest index of potato is presented in Table 4. The results reveal significant variations among treatments, demonstrating the critical role of effective weed control in enhancing crop productivity.

Tuber Yield (t/ha)

The highest tuber yield was observed in the weed-free treatment (24.56 t/ha), followed by Atrazine fb

Metribuzin (22.29 t/ha), indicating that weed control substantially improves potato productivity. The lowest tuber yield (11.64 t/ha) was recorded in the weedy check where uncontrolled weed growth severely limited nutrient availability and plant growth. Among the herbicidal treatments, Metribuzin (19.84 t/ha), Clodinafop + Metribuzin (20.20 t/ha), and Atrazine + Pendimethalin tank mix (19.25 t/ha) also performed well, confirming their efficiency in managing weeds during critical crop stages. These results are consistent with the findings of Lal and Gupta (1984), who reported that unchecked weeds can reduce tuber yield by up to 80%.

Haulms Yield (t/ha)

The weed-free treatment again resulted in the highest haulms yield (7.94 t/ha), while the weedy check recorded the lowest (4.29 t/ha). Among herbicide treatments, Atrazine fb Metribuzin (7.29 t/ha) and Clodinafop + Metribuzin (6.63 t/ha) were particularly effective in promoting vegetative growth by reducing weed competition. Enhanced haulms production in these treatments suggests better resource allocation during early and mid-growth stages, corroborating earlier reports by Gopinath and Mina (2009), who emphasized that herbicide use improves biomass accumulation in potato.

Biological Yield (t/ha)

Biological yield, representing the sum of tuber and haulms yields, followed similar patterns. Weed-free plots recorded the highest biological yield (32.50 t/ha), while the weedy check had the lowest (15.93 t/ha). Among herbicide treatments, Atrazine fb Metribuzin (29.58 t/ha), Clodinafop + Metribuzin (26.83 t/ha), and Metribuzin alone (26.44 t/ha) demonstrated considerable improvements over untreated plots. These results highlight the importance of weed management in maximizing overall biomass production.

Harvest Index (%)

The harvest index, indicating the efficiency of the crop in converting total biomass into economic yield (tubers), varied slightly across treatments. The weed-free plot achieved the highest harvest index (75.56%), followed closely by Atrazine fb Metribuzin (75.36%) and Clodinafop + Metribuzin (75.28%). The lowest harvest index (73.07%) was found in the weedy check. These minor variations suggest that while weed control primarily enhances yield, its effect on assimilate partitioning between haulms and tubers is less pronounced but still significant for improving crop efficiency.

Discussion

The results clearly indicate that weed interference has a profound negative impact on potato yield and growth, whereas timely weed management significantly improves both the economic and biological performance of the crop. The weed-free and Atrazine fb Metribuzin treatments consistently outperformed others, suggesting that a combination of pre and post-emergence herbicide application can provide near-optimal growing conditions without the labour-intensive practices associated with manual weeding.

The relatively higher harvest index observed in well-managed plots confirms that reducing weed competition not only enhances total biomass but also supports better partitioning of assimilates towards tuber development. These findings align with earlier studies by Singh *et al.* (1984) and Bhalla *et al.* (1980), who emphasized that integrated weed management strategies improve yield stability and resource efficiency in potato production.

Moreover, the use of selective herbicides such as Atrazine and Metribuzin, when applied at recommended doses and timings, has proven to be both effective and safe for crop health. Such strategies are particularly important in regions where labour shortages and rising operational costs limit the feasibility of manual weeding.

Conclusion

The study confirms that herbicide-based weed management significantly enhances tuber yield, haulms production, and biological yield in potato. Among the treatments, Atrazine fb Metribuzin emerged as the most effective option, delivering results comparable to the weed-free condition while reducing labour requirements. These findings underscore the importance of adopting integrated weed management approaches that combine chemical and cultural practices to sustain productivity and profitability in potato cultivation.

Table 4 : Effect of different weed control treatments on the grade wise tuber yield of Potato

Tr. No.	Treatment	Tuber yield (t/ha)	Haulms yield (t/ha)	Biological yield (t/ha)	Harvest Index (%)
T_1	Paraquat Dichloro at 450g a.i./ha (EPoE)	16.50	5.77	22.26	74.10
T_2	Quizalofop-p-ethyl at 30g a.i./ha (EPoE)	13.76	4.95	18.71	73.54
T_3	Metribuzin at 500g a.i./ha (PE)	19.84	6.61	26.44	75.02
T_4	Pendimethalin at 1000g a.i./ha (PE)	17.09	5.81	22.91	74.62
T_5	Clodinafop + Metribuzin at 200g a.i./ha RM (PoE)	20.20	6.63	26.83	75.28
T_6	Atrazine at 1000g a.i./ha (PE)	16.00	5.61	21.61	74.04
T_7	Atrazine at 1000g a.i./ha (PE) fb Metribuzin at 500g a.i./ha (PoE)	22.29	7.29	29.58	75.36
T_8	Atrazine at 750g a.i./ha + pendimethalin at 600g a.i./ha Tank mix (PE)	19.25	6.48	25.72	74.82
T_9	Weed free	24.56	7.94	32.50	75.56
T_{10}	Weedy check	11.64	4.29	15.93	73.07
S Em±		0.69	0.22	1.05	
LSD (*p*=0.05)		2.04	0.65	3.11	

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