Plant Archives Vol. 26, Supplement 2, 2026 pp. 2213-2219 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-2.277

WEED INDICES AND CORRELATION STUDY UNDER DIFFERENT PRE AND POST EMERGENCE HERBICIDES IN WHITE ONION (*Allium cepa* L.)

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(Date of Receiving-15-04-2026; Date of Revision-02-06-2026; Date of Acceptance-25-06-2026)

ABSTRACT

Weed infestation is a major constraint in onion due to slow initial growth and poor crop competitiveness. Effective weed management is therefore essential for minimizing crop losses and improving productivity. The present investigation was conducted to evaluate the effect of different weed management practices on weed indices and correlation between yield and weed density and biomass in white onion (*Allium cepa* L.) during *rabi* season of 2023-24 and 2024-25 at Instructional Farm, Department of Agronomy, College of Agriculture, Dapoli, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli. The results of the experiment revealed that treatment T_9 (oxyfluorfen PE *fb* propaquizafop + oxyfluorfen PoE) recorded the highest weed control efficiency (WCE) which was comparable with weed free check (2 hand weeding's @ 20 and 40 DAT). The same treatment also exhibited the lowest weed index, indicating superior weed suppression and better crop performance. Correlation analysis revealed a significant negative relationship between white onion yield and the density and biomass of major weed species, particularly *Physalis minima* L., *Cardiospermum halicacabum* L., and *Digitaria sanguinalis* L., indicating their detrimental effect on crop productivity. The strength of these associations was consistent across both years of study. Based on the findings, T_9 (oxyfluorfen 23.5% EC @ 120 g a.i. ha^{-1} PE *fb* propaquizafop 5% + oxyfluorfen 12% EC (Ready-mix) @ 148.75 g a.i. ha^{-1} PoE) or T_{11} (oxyfluorfen 23.5% EC @ 120 g a.i. ha^{-1} PE *fb* quizalofop ethyl 4% + oxyfluorfen 6% EC (Ready-mix) @ 100 g a.i. ha^{-1} PoE) proved to be the most effective weed management practice for controlling weeds in white onion cultivation.

***Keywords* :** Herbicides, weed indices, white onion, correlation.

Introduction

Onion (*Allium Cepa* L.) is one of the most important bulbous vegetable crops cultivated throughout the world and is valued for its culinary, nutritional, medicinal, and industrial importance. India ranks among the leading onion-producing countries, where onion occupies a substantial area under vegetable cultivation and contributes significantly to farmers' income and export earnings. India is recognized as the foremost onion-producing nation globally, accounting for about 27.16 per cent of total world onion production (Tridge, 2024). The crop is cultivated extensively across the country, covering nearly 1.77 million hectares and producing about 28.88 million tonnes, with an average productivity of 16276 kg ha^{-1} as reported in the first advance estimates (Agricultural Statistics at a Glance, 2024). White onion is particularly important for dehydration industries due to its high total soluble solids and pungency, making it a valuable commercial crop. However, the productivity of onion is often constrained by several biotic and abiotic factors, among which weed infestation is considered one of the major limitations affecting crop growth and yield (Brewster, 2008).

Onion is highly vulnerable to weed competition because of its slow germination, poor seedling vigour, narrow upright leaves, shallow root system, and sparse canopy development during the early growth stages. Owing to these characteristics, onion possesses poor competitive ability against weeds, especially during the critical period of crop-weed competition. Weeds compete aggressively with the crop for nutrients, moisture, light, and space, thereby reducing crop growth, bulb development, and marketable yield. Uncontrolled weed growth in onion may result in yield losses ranging from 40 to 80 per cent depending upon weed flora, duration of infestation, and environmental conditions (Rao, 2000).

The critical period of weed competition in onion generally extends from 20 to 60 days after transplanting or sowing, during which effective weed management becomes essential for ensuring better crop establishment and optimum yield. Traditional weed control practices such as hand weeding and inter-cultivation are effective but labour-intensive, time-consuming, and increasingly expensive due to labour scarcity during peak agricultural operations (Rathod *et al*., 2014). Moreover, continuous rainfall or unfavourable field conditions often hinder timely manual weeding, resulting in severe crop-weed competition.

Under such circumstances, herbicidal weed management offers an effective, economical, and practical approach for weed suppression in onion cultivation. The use of pre-emergence herbicides provides early-season weed control by inhibiting weed seed germination and emergence, thereby reducing weed pressure during the critical crop growth stages. Similarly, post-emergence herbicides help control emerged weeds and extend the weed-free period, ensuring better crop growth and resource utilization. Several researchers have reported promising results with the application of herbicides such as pendimethalin, oxyfluorfen, quizalofop-p-ethyl, and other selective herbicides in onion cultivation for reducing weed density and improving bulb yield.

The assessment of weed management strategies through weed indices provides a comprehensive understanding of the effectiveness of different treatments. Weed indices such as weed control efficiency (WCE) and weed index (WI) are important parameters for evaluating the biological efficiency of herbicides and their influence on crop performance. These indices help in identifying suitable herbicidal combinations that can effectively suppress weeds while minimizing crop damage and maximizing productivity. Weed infestation adversely affects onion growth and yield through competition for essential resources. Studying the relationship between weed density, weed biomass, and crop yield through correlation analysis helps in identifying dominant weed species responsible for maximum yield reduction and facilitates the formulation of efficient weed management practices.

Although several weed management practices have been evaluated in onion, limited information is available regarding the comparative performance of different pre- and post-emergence herbicides on weed indices in white onion under local agro-climatic conditions. Therefore, the present investigation entitled "Weed Indices and Correlation Study under Different Pre and Post Emergence Herbicides in White Onion (*Allium cepa* L.)" was undertaken to evaluate the efficacy of different pre- and post-emergence herbicides in white onion, with the objective of identifying an effective weed management strategy for enhanced crop productivity.

Materials and Methods

A field experiment was conducted during *rabi* season of 2023-24 and 2024-25 at Instructional Farm, Department of Agronomy, College of Agriculture, Dapoli, Dist. Ratnagiri; Maharashtra which lies in the subtropical zone and is geographically positioned at 17°45′55″ N latitude and 73°10′16″ E longitude, with an elevation of nearly 157.8 m above mean sea level. In general, the climatic conditions observed during both the cropping seasons were suitable for satisfactory crop growth. The soil exhibited slight acidity (pH 6.08-6.12) and low electrical conductivity (0.098-0.101 dS m^{-1}) and moderate organic carbon content (12.12-12.15 g kg^{-1}). The experiment was laid out in a Randomized Block Design (RBD) with twelve treatments and three replications. The treatments of white onion comprised of different combinations of pre- and post-emergence herbicides applied either individually or in sequence, along with a weed-free check and an unweeded check serving as control. The herbicidal treatments assessed in the study consisted of pendimethalin 38.7% CS @ 580.5 g a.i. ha^{-1} applied as pre-plant incorporation (PPI), along with pendimethalin 38.7% CS @ 677.25 g a.i. ha^{-1} and oxyfluorfen 23.5% EC @ 120 g a.i. ha^{-1} administered as pre-emergence (PE). In white onion, the post-emergence (PoE) weed control treatments included oxyfluorfen 23.5% EC @ 120 g a.i. ha^{-1} applied during the early post-emergence (EPoE) stage, fenoxaprop-p-ethyl 9.3% EC @ 75 g a.i. ha^{-1}, propaquizafop 5% + oxyfluorfen 12% EC (ready-mix) @ 148.75 g a.i. ha^{-1}, and quizalofop-ethyl 4% +

oxyfluorfen 6% EC (ready-mix) @ 100 g a.i. ha^{-1}. The pre plant incorporation herbicide was applied 2-3 days before transplanting, pre-emergence herbicides were applied 2-3 days after transplanting, early post emergence application was done at 15-20 DAT and post emergence herbicides were applied at 25-30 DAT.

White onion variety 'Alibaug Local' was transplanted on flat beds by adopting the spacing of 20 cm × 15 cm. Herbicides were applied as per treatment using a hand-operated knapsack sprayer equipped with a flat-fan nozzle at a spray volume of 500 L ha^{-1}, while hand weeding in the weed-free check was performed according to the scheduled intervals. Uniform recommended agronomic practices were followed for all treatments throughout the experimental period during both the years. Fertilizer and plant protection measures were implemented as per standard recommendations, with white onion receiving 100:50:50 kg N: P_2O_5: K_2O ha^{-1}. Weed indices were computed by using formulas as mentioned below;

1. Weed Control Efficiency (WCE %)

WCE indicates the effectiveness of a treatment in reducing weed biomass compared to unweeded control. It was computed by using formula given by Kondap and Upadhyay (1985).

$$\text{WCE (\%)} = \frac{(DW_C - DW_T)}{DW_C} \times 100$$

Where,
WCE = Weed control efficiency
DW_C = Dry weight of weeds in unweeded control
DW_T = Dry weight of weeds in treated plot

2. Weed Index (%)

WI measures the reduction in crop yield due to weed competition in comparison to weed-free condition (Gill and Kumar, 1969).

$$\text{WI (\%)} = \frac{(Y_{WF} - Y_T)}{Y_{WF}} \times 100$$

Where,
Y_{WF}= Crop yield in weed-free/best treatment plot
Y_T= Crop yield in treated plot of which WI to be calculated.

3. Weed persistence index (WPI)

WPI evaluates weed persistence considering weed density and biomass under different treatments. It was calculated by using formula as given by Mishra and Mishra (1997).

$$\text{WPI}=\frac{\text{(Weed population in control plot)}}{\text{(Weed population in treated plot)}}\times\frac{\text{(Weed dry weight in treated plot)}}{\text{(Weed dry weight in control plot)}}$$

4. Weed Management Index (WMI)

This index indicates the association between yield improvement over the control achieved through weed management practices and the corresponding reduction in weed population under a given treatment. It was computed using the formula proposed by Kewat and Jha (2018)

$$\text{WMI}=\frac{\text{Percent crop yield increase over control}}{\text{Percent control of weeds}}$$

5. Agronomic Management Index (AMI)

AMI assesses agronomic superiority of a treatment over control based on yield performance (Gupta, 2011).

$$\text{AMI}=\frac{\text{(Percent crop yield increase over control)-(Percent control of weeds)}}{\text{Percent control of weed}}$$

6. Integrated Weed Management Index (IWMI)

IWMI combines agronomic and weed management effects into a single index. It was calculated by following formula proposed by Gupta (2011);

$$\text{AMI}=\frac{\text{WMI+AMI}}{2}$$

Where,
IWMI= Integrated Weed Management Index
WMI = Weed Management Index
AMI = Agronomic Management Index

Results and Discussion

Weed Indices

The results of the experiment revealed that various weed indices were influenced by different treatments during both the years and pooled mean (Table 1 and Fig. 1). The weed-free check (T_1) recorded the highest pooled WCE (99.23%). Among the herbicidal treatments, T_9 (oxyfluorfen PE *fb* propaquizafop + oxyfluorfen PoE) registered the maximum WCE (91.65%), followed by T_{11} (90.37%), and remained highly effective. Treatments T_4 (pendimethalin *fb* oxyfluorfen) and T_8 (pendimethalin *fb* propaquizafop + oxyfluorfen) also exhibited higher WCE.

Weed index was markedly influenced by different weed management treatments during both years and in pooled mean (Table 1). The unweeded control (T_2) recorded the highest weed index, indicating substantial yield reduction due to uncontrolled weed growth. Among the herbicidal treatments, T_9 (oxyfluorfen PE *fb* propaquizafop + oxyfluorfen PoE) registered the lowest weed index, followed by T_{11} and T_4, reflecting better yield protection through effective season-long weed control. The higher WCE recorded under these treatments may be due to efficient weed control by oxyfluorfen applied at both pre- and post-emergence stages, along with its prolonged residual effect in the soil. The weed index (WI), indicating yield loss caused by weed competition, was lowest under the weed-free check and effective herbicidal treatments, particularly T_9 and T_{11}, reflecting reduced yield losses during both years. Lower WI values were associated with better weed suppression, which minimized competition for essential resources and enhanced crop productivity. In contrast, higher WI values in less effective treatments and unweeded control resulted from severe weed interference, causing considerable yield reduction. Similar observations were reported by Reddy *et al*. (2015), Gohil *et al*. (2024), Fatima *et al*. (2017) and Chaudhari *et al*. (2024).

The weed persistence index (WPI) of white onion at harvest was significantly affected by different weed management treatments during both years and in pooled analysis (Table 1). Higher WPI values observed in some effective treatments may be due to the composite nature of the index, which considers weed density, biomass, and crop yield. Despite effective weed suppression, variations in yield response and index components may have contributed to relatively higher WPI values, indicating apparent weed persistence rather than ineffective weed control.

Weed management indices differed significantly among treatments in both years and pooled analysis (Fig. 1). The weed-free check (T_1) recorded higher Weed Management Index (WMI), Agronomic Management Index (AMI), and Integrated Weed Management Index (IWMI) values, indicating effective weed control and improved crop performance. Among herbicidal treatments, T_{10} (oxyfluorfen PE *fb* fenoxaprop-p-ethyl PoE) registered the highest pooled indices, followed by T_6 (propaquizafop 5% + oxyfluorfen 12% EC PoE) and T_7 (quizalofop ethyl 4% + oxyfluorfen 6% EC PoE). Treatments T_5 (oxyfluorfen PE), T_8 (oxyfluorfen PE *fb* propaquizafop PoE), T_9 (oxyfluorfen PE *fb* propaquizafop + oxyfluorfen PoE), T_{11} (oxyfluorfen PE *fb* quizalofop ethyl PoE), and T_{12} (oxyfluorfen PE *fb* quizalofop ethyl + oxyfluorfen PoE) also recorded comparatively higher indices and remained comparable with the weed-free check. Overall, sequential and integrated herbicide applications effectively reduced weed interference and enhanced white onion productivity. The results are similar to those reported by Donga *et al*. (2023).

Correlation Matrix

The correlation analysis revealed that the density and biomass of most weed species were negatively associated with white onion yield at 60 DAT during *rabi* 2023-24 (Table 2), indicating that increased weed infestation reduced crop productivity due to competition for essential resources such as nutrients, moisture, light and space. Among all weed species, *Physalis minima* L. exhibited the strongest negative association with yield, with correlation coefficients of -0.890 for density and -0.925 for biomass. These relationships were statistically significant, suggesting that *P. minima* were the most competitive weed species and caused the greatest yield reduction. Similarly, *Digitaria sanguinalis* L. showed significant negative correlations with yield, both for density (r = -0.740) and biomass (r = -0.810), indicating that increased infestation of this grassy weed substantially reduced crop performance. *Cardiospermum halicacabum* L. also recorded significant negative correlations, with yield showing correlation coefficients of -0.730 for density and -0.674 for biomass, demonstrating its considerable competitive effect on white onion.

Table 1 : Weed control efficiency (%) at 40 DAT, weed index (%) and weed persistence index at harvest index as influenced by different treatments of white onion during *rabi* 2023-24, 2024-25 and in the pooled mean

Treatments	Weed Control Efficiency (%) at 40 DAT			Weed index (%)			Weed persistence index		
	2023-24	2024-25	Pooled	2023-24	2024-25	Pooled	2023-24	2024-25	Pooled
T_1: Weed free check (2 hand weeding's @ 20 and 40 DAT)	99.09	99.36	99.23	0.00	0.00	0.00	1.06	1.10	1.08
T_2: Unweeded check (control)	0.00	0.00	0.00	53.03	56.99	55.01	1.00	1.00	1.00
T_3: Pendimethalin @ 580.5 g a.i. ha^{-1} PPI	10.15	32.13	21.14	36.49	40.83	38.66	0.67	0.66	0.67
T_4: Pendimethalin @ 580.5 g a.i. ha^{-1} PPI *fb* oxyfluorfen @ 120 g a.i. ha^{-1} EpoE	77.54	84.23	80.88	10.10	10.86	10.48	1.38	0.91	1.15
T_5: Pendimethalin @ 580.5 g a.i. ha^{-1} PPI *fb* fenoxaprop-p-ethyl @ 75 g a.i. ha^{-1} PoE	38.14	35.52	36.83	23.10	27.70	25.40	0.62	0.74	0.68
T_6: Propaquizafop 5 % + oxyfluorfen 12 % EC (RM) @ 148.75 g a.i. ha^{-1} PoE	60.87	58.81	59.84	13.67	19.20	16.44	0.76	0.84	0.80

T_7: Quizalofop ethyl 4 % + oxyfluorfen 6 % EC (RM) @ 100 g a.i. ha^{-1} PoE	50.67	57.07	53.87	15.16	19.88	17.52	0.83	0.89	0.86
T_8: Pendimethalin @ 677.25 g a.i. ha^{-1} PE *fb* propaquizafop + oxyfluorfen @ 148.75 g a.i. ha^{-1} PoE	79.53	82.04	80.78	11.16	12.63	11.89	1.17	1.21	1.19
T_9: Oxyfluorfen @ 120 g a.i. ha^{-1} PE *fb* propaquizafop + oxyfluorfen 12 @ 148.75 g a.i. ha^{-1} PoE	89.42	93.88	91.65	2.38	3.23	2.81	1.76	1.47	1.61
T_{10}: Oxyfluorfen @ 120 g a.i. ha^{-1} PE *fb* fenoxaprop-p-ethyl @ 75 g a.i. ha^{-1} PoE	48.52	55.14	51.83	15.71	16.84	16.27	1.00	0.94	0.97
T_{11}: Oxyfluorfen @120 g a.i. ha^{-1} PE *fb* quizalofop ethyl + oxyfluorfen @ 100 g a.i. ha^{-1} PoE	88.62	92.12	90.37	4.08	6.15	5.11	1.47	1.06	1.27
T_{12}: Pendimethalin @ 677.25 g a.i. ha^{-1} PE *fb* quizalofop ethyl + oxyfluorfen @ 100 g ha^{-1} PoE	69.95	76.88	73.42	12.55	12.09	12.32	0.85	0.74	0.79

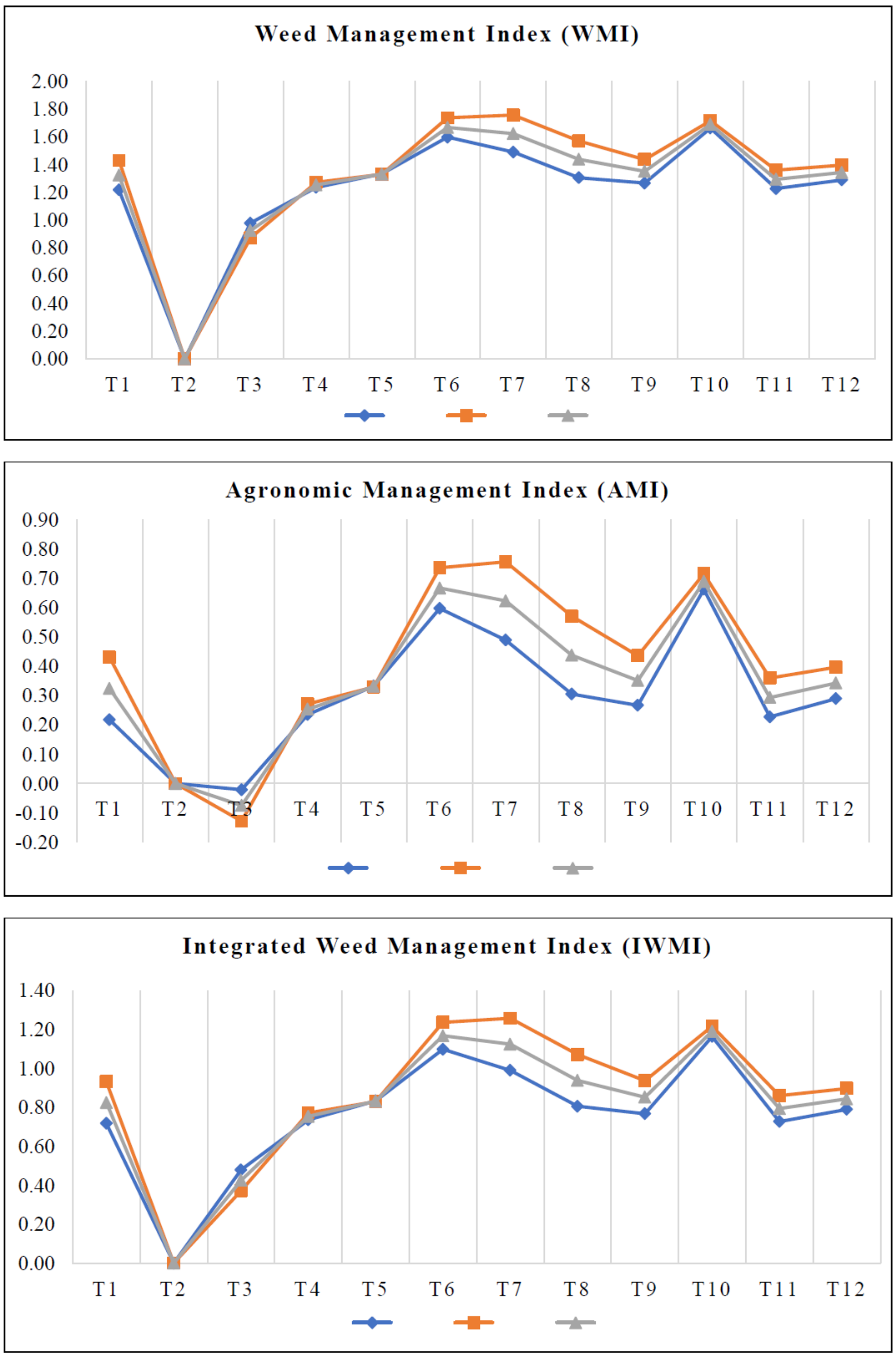

Fig. 1 : Weed indices as influenced by different treatments in white onion during *rabi* 2023-24, 2024-25 and the pooled mean.

Similarly, *Physalis minima* L. was the most competitive weed species, exhibiting the strongest negative relationship with white onion yield during *rabi* 2024-25 (Table 3). The correlation coefficients between yield and *Physalis minima* L. density (r = -0.880) and biomass (r = -0.898) were highly significant, suggesting that increases in *Physalis minima* L. infestation substantially reduced crop yield. *Digitaria sanguinalis* L. also showed strong and significant negative correlations with yield for both density (r = -0.790) and biomass (r = -0.788). This indicates that greater *Digitaria sanguinalis* L. population and dry matter accumulation resulted in considerable yield losses. Similarly, *Cardiospermum halicacabum* L. density recorded a strong and significant negative association with yield (r = -0.720), whereas its biomass showed a strong negative correlation (r = -0.703) but was statistically non-significant at the higher level of significance tested. Similar results were reported by Verma *et al*. (2023) in cowpea, Barla and Upasani (2022) in soybean and Gupta *et al*. (2013) in urdbean.

Conclusion

The two-year study indicated that favourable weed indices in white onion were obtained with oxyfluorfen 23.5% EC @ 120 g a.i. ha^{-1} PE followed by either propaquizafop 5% + oxyfluorfen 12% EC (ready-mix) @ 148.75 g a.i. ha^{-1} PoE or quizalofop ethyl 4% + oxyfluorfen 6% EC (ready-mix) @ 100 g a.i. ha^{-1} PoE, owing to their effective suppression of weed growth and reduced crop-weed competition. Findings also demonstrated that increased density and biomass of dominant weed species adversely affected white onion yield, with *Digitaria Sanguinalis* L., *Cardiospermum halicacabum* L., and *Physalis minima* L. exerting the greatest competitive pressure.

Acknowledgement

The authors express their sincere gratitude to the Department of Agronomy, College of Agriculture, Dapoli, and Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, for extending the required infrastructure, experimental facilities, and technical assistance that enabled the successful completion of this study.

Competing Interests

The authors confirm that there are no conflicts of interest, financial or otherwise, associated with this research work.

Table 2 : Correlation matrix between bulb yield (q/ha) and density and biomass of different weed species at 60 DAT as influenced by weed management practices during *rabi* 2023-24

	Bulb Yield (q/ha)	*D. sanguinalis WD*	*D. sanguinalis WB*	*C. halicacabum WD*	*C. halicacabum WB*	*P. minima WD*	*P. minima WB*	*C. viscosa WD*	*C. viscosa WB*	*C. argentea WD*	*C. argentea WB*
Bulb Yield (q/ha)	1										
D. sanguinalis WD	-0.740**	1									
D. sanguinalis WB	-0.810**	0.910**	1								
C. halicacabum WD	-0.730**	0.519	0.432	1							
C. halicacabum WB	-0.674*	0.454	0.370	0.926**	1						
P. minima WD	-0.890**	0.564	0.588*	0.760**	0.607*	1					
P. minima WB	-0.925**	0.583*	0.616*	0.786**	0.673*	0.987**	1				
C. viscosa WD	-0.026	0.099	-0.187	0.201	0.163	0.227	0.175	1			
C. viscosa WB	0.176	-0.089	-0.266	-0.238	-0.054	-0.235	-0.217	0.700*	1		
C. argentea WD	-0.546	0.870**	0.797**	0.429	0.356	0.453	0.466	0.133	-0.076	1	
C. argentea WB	-0.421	0.786**	0.714**	0.214	0.261	0.227	0.268	0.164	0.216	0.919**	1

**: Significant at $P \leq 0.01$ *: Significant at $P \leq 0.05$
WD: Weed density, WB: Weed biomass

Table 3 : Correlation matrix between bulb yield (q/ha) and density and biomass of different weed species at 60 DAT as influenced by weed management practices during *rabi* 2024-25

	Bulb Yield (q/ha)	***D. sanguinalis WD***	***D. sanguinalis WB***	***C. halicacabum WD***	***C. halicacabum WB***	***P. minima WD***	***P. minima WB***	***C. viscosa WD***	***C. viscosa WB***	***C. argentea WD***	***C. argentea WB***
Bulb Yield (q/ha)	1										
D. sanguinalis WD	-0.790**	1									
D. sanguinalis WB	-0.788**	0.906**	1								
C. halicacabum WD	-0.720**	0.659*	0.497	1							
C. halicacabum WB	-0.703*	0.513	0.391	0.914**	1						
P. minima WD	-0.880**	0.616*	0.610*	0.706*	0.645*	1					
P. minima WB	-0.898**	0.569	0.568	0.709**	0.726	0.976	1				
C. viscosa WD	-0.054	0.150	-0.099	0.350	0.207	0.257	0.175	1			
C. viscosa WB	0.115	-0.067	-0.238	0.002	-0.026	-0.024	-0.053	0.860**	1		
C. argentea WD	-0.529	0.863**	0.771**	0.590*	0.448	0.487	0.427	0.301	0.081	1	
C. argentea WB	-0.471	0.779**	0.744**	0.467	0.398	0.397	0.367	0.238	0.136	0.963**	1

**: Significant at $P \leq 0.01$ *: Significant at $P \leq 0.05$ WD: Weed density, WB: Weed biomass

References

Agricultural Statistics at a Glance. (2024). *Agricultural Statistics at a Glance 2024*. Ministry of Agriculture and Farmers Welfare, Department of Agriculture and Farmers Welfare, Economics, Statistics and Evaluation Division, Government of India.

Barla, S., Binjha, K. K., & Upasani, R. R. (2022). Weed dynamics, growth, yield and correlation study as affected by weed control methods in soybean (*Glycine max* L. Merril). *Legume Research*. Advance online publication. https://doi.org/10.18805/LR-4922

Bhasker, P., Gupta, P. K., & Borade, S. S. (2024). Herbicides for weed management in onion and analysis of herbicide residues using liquid chromatography tandem mass spectrometry. *Indian Journal of Weed Science*, **56**(2), 176–185.

Brewster, J. L. (2008). *Onions and other vegetable alliums* (2nd ed.). CABI Publishing.

Chaudhari, D. D., Patel, V. J., Patel, H. K., & Patel, B. D. (2024). Complex weed flora management through herbicides in nursery and transplanted onion. *Indian Journal of Weed Science*, **56**(1), 52–58.

Donga, R. R. (2023). *Bio-efficacy evaluation of herbicides for weed management in rabi onion* (Master's thesis). Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh, India.

Fatima, Q. N. (2017). *Comparative efficiency of pre and post emergence herbicides on weed control and productivity of onion (Allium cepa L.)* (Master's thesis). Department of Horticulture, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, India.

Gill, G. S., & Kumar, V. (1969). Weed index: A new method for reporting weed control trials. *Indian Journal of Agronomy*, **16**(2), 96–98.

Gohil, B. S., Solanki, B. P., Kadivar, M. R., & Donga, R. R. (2024). Bio-efficacy evaluation of herbicides for weed management in rabi onion. *Archives of Current Research International*, **24**(5), 535–542.

Gupta, O.P. (2011). *Modern weed management* (4th ed.). Agrobios (India).

Gupta, V., Singh, M., Kumar, A., Sharma, B. C., & Kher, D. (2013). Influence of weed management practices on weed dynamics and yield of urdbean (*Vigna mungo*) under rainfed conditions of Jammu. *Indian Journal of Agronomy*, **58**(2), 220–225.

Kewat, M. L., & Jha, A. K. (2018). *A manual on weeds*. Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya.

Kondap, S. M., & Upadhyay, U. C. (1985). *A practical manual of weed control*. Oxford & IBH Publishing.

Kulkarni, S., Biradar, S. A., & Chittapur, B. M. (2017). Bio-efficacy of herbicides against weed complex in onion (*Allium cepa*). *Environment and Ecology*, **35**(1B), 540–543.

Mishra, M., & Mishra, A. (1997). Estimation of IPM index in jute: A new approach. *Indian Journal of Weed Science*, **29**, 39–42.

Rao, V. S. (2000). *Principles of weed science* (2nd ed.). Science Publishers.

Rathod, A. D., Solanki, R. M., Modhavadia, J. M., & Padamani, D. R. (2014). Efficacy of pre- and post-emergence herbicides in onion and their carry over effect on the succeeding crops. *Annals of Agricultural Research*, **35**(2), 209–216.

Reddy, M. V., Umajyothi, K., Reddy, S. S., & Sasikala, K. (2015). Effect of pre and post emergence herbicides on weed dynamics in onion (*Allium cepa* L.) cv. N-53. *The Journal of Research PJTSAU*, **43**(4), 16–21.

Sahu, M. R., Mahapatra, A., & Jha, M. K. (2020). Effect of different weed management practices on onion (*Allium cepa* L.). *The Pharma Innovation Journal*, **9**(4), 170–175.

Tridge. (2024). *Fresh onion production by country*. https://www. tridge.com/intelligences/onion

Verma, K. C., Singh, H., Meena, R., Khan, M., Attar, S. K., Khatik, C. L., Mahala, S. C., & Dhaka, S. R. (2023). Correlation coefficient and path analysis between grain yield and growth parameters, weed and yield attributes of cowpea (*Vigna unguiculata* L.) as influenced by weed management practices under rainfed condition. *The Pharma Innovation Journal*, **12**(6), 2142–2146.