Readers Insight
Publisher of open access books and journals
PJMLS
Print ISSN: 2707-4471. Online ISSN: 2707-448X

Research Article	Pak-Euro Journal of Medical and Life Sciences
DOI: 10.31580/pjmls.v7iSp2.3187	Copyright © All rights are reserved by Corresponding Author
Vol. 7 No. Special 2, 2024: pp. S309-S316	
www.readersinsight.net/pjmls	**Revised:** December 21, 2024 **Accepted:** December 29, 2024
Submission: August 19, 2024	**Published Online:** December 31, 2024

WEED CONTROL PRACTICES IN WHEAT (*TRITICUM AESTIVUM* L.) WITH SPECIAL EMPHASIS ON LINE SPACING AND SEED RATE

Wajiha Anum[1]*, Zeenat Javeed[2], Fida Hussain[3], Aatazaz Ahmad[4], Asad-ur-Rahman[1], Abdul-Majid Khan[1], Waseem Hassan[2], Mehreen Khalid[1], Ruqeyah Abdul Majeed[5], Khurram Shahzad[6]

[1]**Regional Agricultural Research Institute,** Bahawalpur, Pakistan
[2]**Soil and Water Testing Laboratory for Research,** Bahawalpur, Pakistan
[3]**Wheat Research Institute, Ayub Agriculture Research Institute**, Faisalabad, Pakistan
[4]**Deputy Director Soil Conservation**, Pindi Gheb, Pakistan
[5]**Rice Research Institute, Kala Shah Kaku**, Pakistan
[6]**Soil and Water Testing Laboratory For Research,** Gujranwala, Pakistan

***Corresponding Authors:** Wajiha Anum E. mail: wajiha_anum@live.com

Abstract

Wheat (Triticum aestivum L.), being the staple food of Pakistan is in high demand in order to achieve the food necessity of people, yet owing to biotic and abiotic stresses, its yield is decreasing drastically. Climate change has caused a shift in crop maturity duration and ultimately impacts grain yield. In order to achieve a sustainable balance in crop yield, the emphasis on biotic stress factors should also be focused. Weeds hoist yield loss, create physiological and biochemical imperfections and cause crop losses through competition and allelopathic interactions. This study was designed to evaluate weed control in wheat crops by adopting cultural control practices. The research was carried out at Regional Agricultural Research Institute Bahawalpur from 2022 to 2024. This trial comprised of six treatments viz. sowing of wheat under 15 cm apart single row spacing, 15 cm apart cross row spacing, 30 cm apart single row spacing with increased seed rate, 30 cm apart cross row spacing with increased seed rate, chemical treatment and comparison with control was made. RCBD factorial design with three replications was used to evaluate the trial statistically. Growth parameters were observed along with Principal component analysis. The results revealed that 30 cm apart cross row spacing with increased seed rate provided highest grain yield (4770.8 kg/ha) followed by chemical control (3905 kg/ha) and 15 cm apart cross row spacing (3879 kg/ha). The results of this study rendered positive aspects for farmers who lack economic resources for weedicide, as well as discouraged the use of herbicide thus ensuring sustainable agricultural practices.

Keywords: *Cross row spacing, Row spacing, Seed rate, Triticum aestivum L., Weed control*

INTRODUCTION

Wheat (*Triticum aestivum* L) is among the most cultivated crop of Pakistan and dominates other cereals in terms of acreage and production (1). Wheat has high production ability and quality uses from domestic to industrial level (2-4). During the last year about 9.2 million hectares of Pakistan land was under wheat cultivation and produced about 27.5 million tons of wheat grain. Wheat contributes in country GDP (1.8%) and value added in agriculture (9.2%), however there are certain factors which threats wheat production and yield is still under its potential levels due to certain management constraints. Among them, poor crop management practices, lack of irrigation facilities, biotic and abiotic stresses like insect, pests, diseases and climate change are the major ones (2).

Weeds pose serious threats to the agricultural system by reducing the quality and quantity of the final produce. Hashim *et al.,* (5) stated that according to 96% farmers, *Phalaris minor* was most important weed in wheat field followed by *Avena fatua* L. (94%). The primary weed management practice is control through chemical means, but it is detrimental for the well-being of environment, moreover the chemical residue damages the ecosystem and may enter the food chain via consumption of affected grains. There is a dire need to devise alternative to chemical control plans for weed control. The implementation of cultural weed control, use of natural plant extracts, and use of varieties that can withstand stresses can be a good solution in this regard (6). Increasing the populations of crop plants in the row is an effective strategy for suppressing weeds and achieving higher yields (7). De Cauwer *et al,* (8) found that narrow intra-row spacings reduced weed biomass and increased total and commercial spinach biomass. Similar reports indicated that the use of increased plant populations within the row can improve the competitiveness of even low-competitive crops with slow early growth rates (9). Moreover, the seed yield increased linearly with increasing phosphorus levels (10).

Weeds are successfully managed via implementation of cultural weed management practices like sowing of wheat crop in an appropriate row orientation and vigorous wheat varieties are reported previously (11, 12). Sowing of wheat crop to appropriate rows row orientation to sunlight has affirm that cultural weed control can suppress weeds as well as enhance crop production (11, 13). By incorporating such management practices an environment friendly weed control plan can be made for wheat crop (12, 14) .

Weeds are the drastic enemies for major crops and their overtaking creates major yield losses (15) due to their competitive nature for water nutrient and light (16). It has become the most important biotic stress that render in low yield is not managed on time. Chauhan (17) stated 100 billion dollars losses due to weeds worldwide while Swanton *et al,* (18) had stated that 25 billion dollars are used to control weeds. Arid and semi-arid countries including Pakistan are prone to drought stress. Climate extremes are threatening sustainable development goals (19), and our country is vulnerable to the changing climatic extremes (20,21). The deficit rainfall during summer monsoon and prolong impacts on winter crops along with increased evapotranspiration rate under extreme heat is making water deficient situations for crops (22) . However, in such conditions, the hardiness of weeds makes them survive and make them stronger against climate sensitive crops (23).

The predominant weeds of wheat crops are *Phalaris minor*, *Avena fatua*, *Chenopodium album* and *Rumex dentatus* causing considerable reduction in crop growth and yield, (24). By keeping in view, the importance of weed management in wheat crop, this study aims to determine cultural control practices like row orientation and seed rate on weed management.

MATERIALS AND METHODS

STUDY AREA AND SITE DESCRIPTION

This study was carried out at the research farm of regional agricultural research institute, Bahawalpur, Pakistan. The site is located at 29.3544° N, 71.6911° E and elevation of 118m. The site experiences hot dry summers and cool winters. The soil characteristics are depicted in Table I.

Table I. Soil characteristics of the study site

Depth (inches)	EC dS m^{-1}	pH	OM (%)	Available K (ppm)	Available P (ppm)	Texture
0-6	3.2	8.3	0.59	116	7.8	Loam
6-12	2.9	8.2	0.54	110	7.4	Loam

EXPERIMENTAL SET UP AND TREATMENTS

The trial followed RCBD layout with three replications. The plot size was maintained as 3mx8m. all management practices were kept constant for all treatments. It comprised of six treatments viz. Control, chemical, 15 cm apart single row spacing, 15 cm apart cross row spacing, 30 cm apart single row spacing with increased seed rate, 30 cm apart cross row spacing with increased seed rate. The sowing of the trial was done during the first fortnight of November in both years.

Table II. Characteristics of wheat variety ‘Gold-16’

Yield potential	High- 7900 kg/ha
Biotic stress	Rust resistant
Abiotic stress	Drought tolerant
Physiological	Shattering resistant
Grain	Shining and attractive grain color
Protein percentage	13.1-14.1 %

Three Irrigations were applied at tillering, booting and anthesis stage respectively while fertilizers were applied according to the recommended doses. Wheat variety 'gold-16' was the tested variety and had characteristics as given in Table II. As this variety is released for arid and semi-arid areas, hence testing it for row spacing is crucial for farmers of southern Punjab, Pakistan.

STATISTICAL ANALYSIS

The data was subjected to one way ANOVA and means were compared by applying lsd at 5% probability level. Principal component analysis and correlation matrix was also produced. All statistical analysis was carried out using the software 'OriginPro'.

RESULTS AND DISCUSSION

The results of our study showed that row spacing and seed rate impose significantly different results in most of the observed parameters. The highest plant population was observed in 15 cm apart cross row spacing as 480.67 plants/m2 followed by 30 cm apart cross row spacing with increased seed rate as 424 plants/m2 (Fig. 1). Plant height was maximum in 15 cm apart cross row spacing however all other treatments were also statistically at par to each other showing non-significant differences among them (Fig. 2).

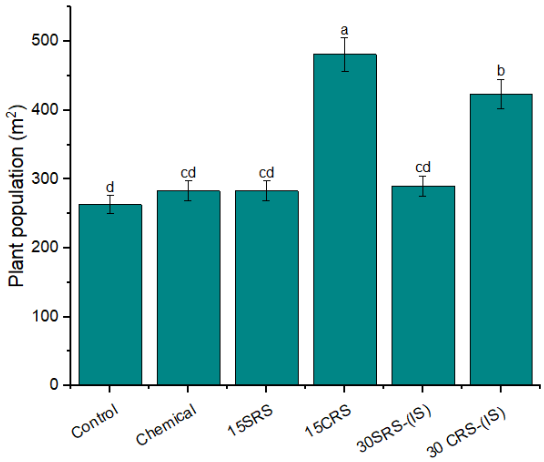

Fig. 1. Impact of cultural weed control methods on plant population in wheat crop where control: plot with no amended row spacing; chemical: herbicide applied plot; 15SRS: 15 cm apart single row spacing; 15CRS: 15 cm apart cross row spacing;30SRS-(IS): 30 cm apart single row spacing with increase seed rate: 30 CRS-(IS): 30 cm apart cross row spacing with increased seed rate. The means are compared at 0.05 Lsd

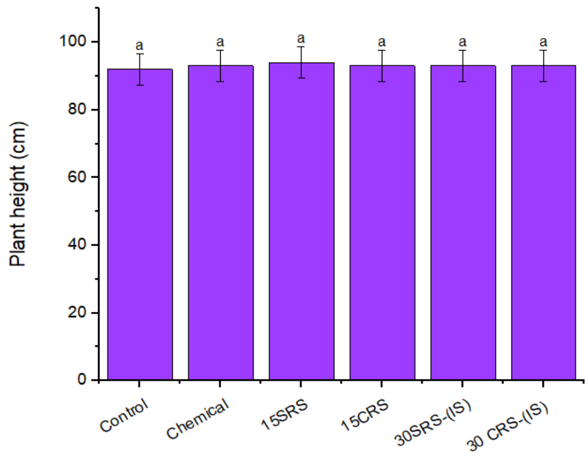

Fig. 2. Impact of cultural weed control methods on plant height in wheat crop where control: plot with no amended row spacing; chemical: herbicide applied plot; 15SRS: 15 cm apart single row spacing; 15CRS: 15 cm apart cross row spacing;30SRS-(IS): 30 cm apart single row spacing with increase seed rate: 30 CRS-(IS): 30 cm apart cross row spacing with increased seed rate. The means are compared at 0.05 Lsd

Spike length also varied significantly among the treatments. For spike length 15 cm apart cross row spacing, 30 cm apart single row spacing with increased seed rate and 30 cm apart cross row spacing with increased seed rate gave highest values (Table II, Fig. 3).

As far as the final grain yield is concerned 30 cm apart cross row spacing with increased seed rate gave the highest yield (4770.8 kg/ha) followed by chemical control (3905.1 kg/ha) and 15 cm apart cross row spacing (3879.6 kg/ha). The least grain yield was obtained in control/weedy check (3231.5 kg/ha). The comparison between all treatments is depicted in Fig. 4.

The principal component analysis was performed in order to know the relationship among the observed variables. The results show that 58.35% variation occurred on PC1 while 25.46% occurred on PC2. Loading plot showed a clear depiction that four measured parameters were correlated to each other. Fig. 5a shows that grain yield and plant population share a very small angle between the vectors thus affirming a significantly positive relationship between these two. While plant height and plant population shared larger angle and had relatively less relationship among them. As far as the scores plot (Fig. 5b) is concerned, the placement of 30 CRS-(IS) and 15CRS nearer to each other show their similar performance.

The control treatment is situated far away from all remaining treatments thus showing that it performed differently in comparison to other treatments. The combined vectors and scores are depicted in biplot (Fig. 5c).

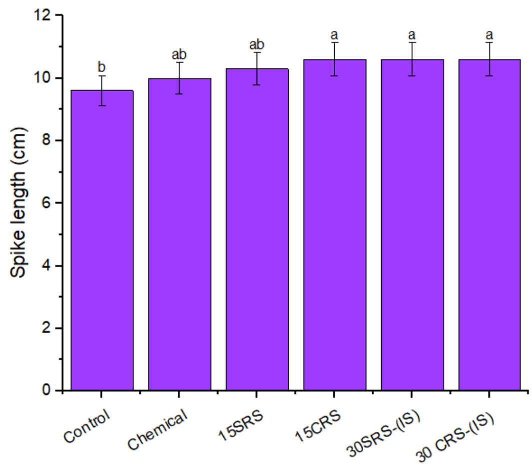

Fig. 3. Impact of cultural weed control methods on spike length in wheat crop where control: plot with no amended row spacing; chemical: herbicide applied plot; 15SRS: 15 cm apart single row spacing; 15CRS: 15 cm apart cross row spacing;30SRS-(IS): 30 cm apart single row spacing with increase seed rate: 30 CRS-(IS): 30 cm apart cross row spacing with increased seed rate. The means are compared at 0.05 Lsd

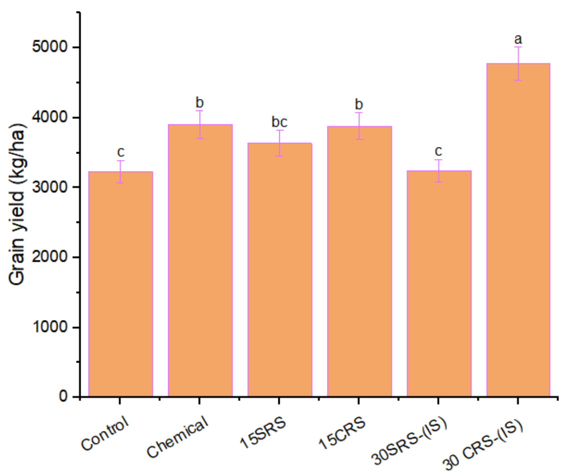

Fig. 4. Impact of cultural weed control methods on grain yield in wheat crop where control: plot with no amended row spacing; chemical: herbicide applied plot; 15SRS: 15 cm apart single row spacing; 15CRS: 15 cm apart cross row spacing;30SRS-(IS): 30 cm apart single row spacing with increase seed rate: 30 CRS-(IS): 30 cm apart cross row spacing with increased seed rate. The means are compared at 0.05 Lsd

DISCUSSION

In our results, the results showed that row orientation can significantly impact the weed infestation and ultimately reduces the grain yield in wheat crop. In this regard, previously Holt (25) suggested that altered crop row spacing reduces the ability of weeds to intercept light. Similarly, Barberi (26) stated that narrow crop row spacing results in higher crop shading which controls weed without extra chemical inputs. The crops get a competitive edge by producing early and rapid canopy closure (27-30). Sowing wheat crop in a uniform pattern reduces the total amount of light reaching smaller weeds as it is exponential nature of light to extinct within the canopies (31). Resources availability is the crucial step that determines the extend of crop weed competition, environmental factors like temperature, light, space are significant as well (31, 32)

An inverse relationship has been found between narrow crop rows and weed growth in plants like wheat, rice, barley, cotton, millet, sorghum and soybean (27, 29, 33-37). Wider rows in crop can facilitate intercultural practices however, narrower rows suppress weed growth in wheat (38).

Lemerle *et al,* (39) stated that in addition to row spacing, seed rate also impact wheat yield as in the presence of *L. rigidum*, row spacing did not impact grain yield but it was reduced significantly at lower seed rates. Higher crop density suppressed Lolium *rigidum* which was also unaffected by row spacing. Grain yield was maximized when post-emergence herbicide was applied at 60–100% of the recommended dose at wheat densities >~300 plants/m^2.

In another study it was revealed that narrow row spacing in wheat delays the time for weed emergence thus giving competitive edge over weeds (40). Fahad *et al,* (40) carried out an experiment in which wheat was sown at 11, 15 and 23 cm apart rows. The weed emergence (*gallium aparine* and *Lepidium sativum*) time was noted. They revealed that narrow row spacing (11 cm) reduces growth of both weeds and increased wheat growth in comparison to 15 cm and 23 cm row spacing.

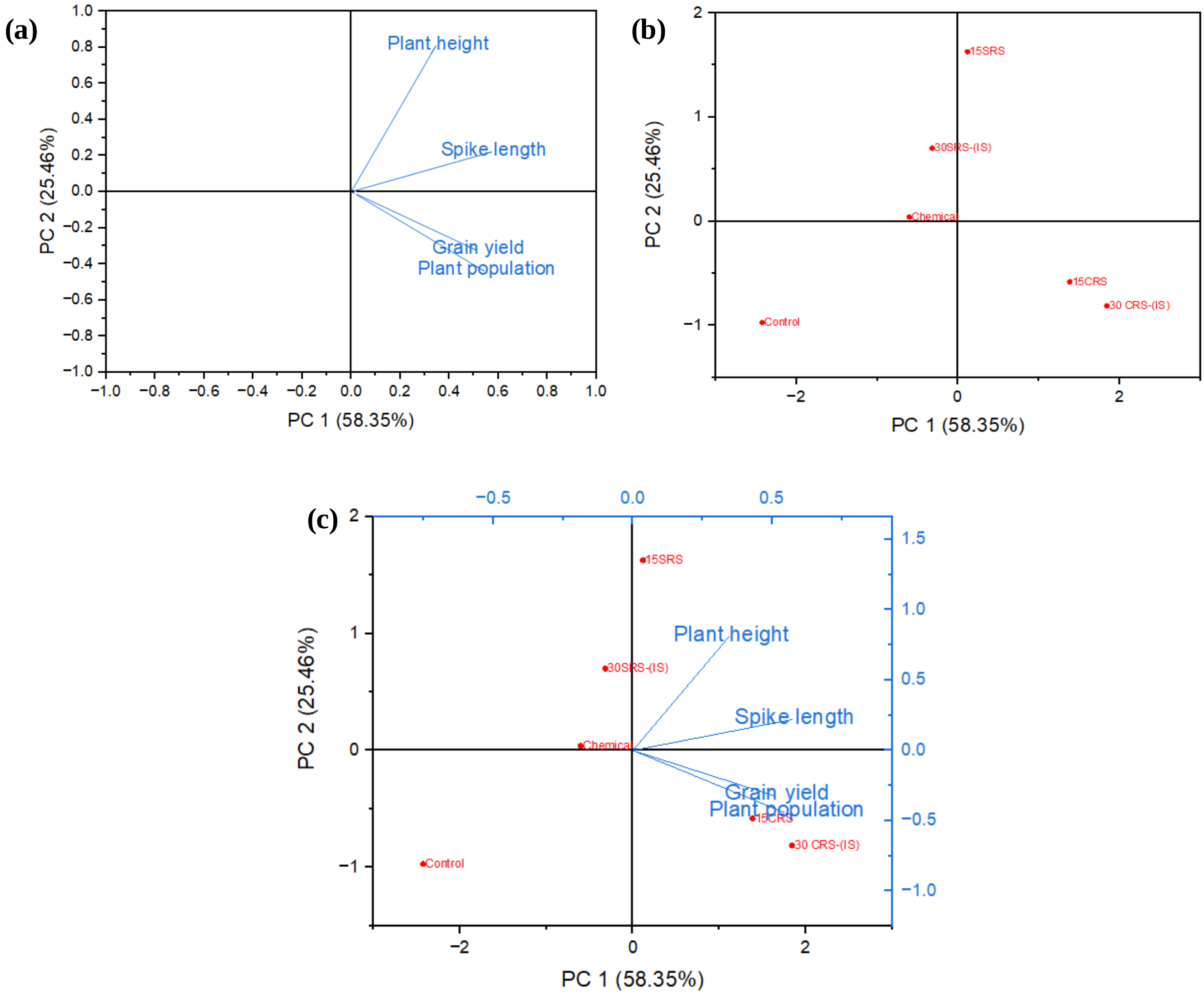

Fig. 5(a). PCA loading plot where x axis is PC1 and y axis is PC2, the angles between vectors determined relationship between variables; **(b).** PCA scores plot where x axis has PC1 and y axis has PC2, control: plot with no amended row spacing; chemical: herbicide applied plot; 15SRS: 15 cm apart single row spacing; 15CRS: 15 cm apart cross row spacing;30SRS-(IS): 30 cm apart single row spacing with increase seed rate: 30 CRS-(IS): 30 cm apart cross row spacing with increased seed rate; **(c).** PCA biplot where control: plot with no amended row spacing; chemical: herbicide applied plot; 15SRS: 15 cm apart single row spacing; 15CRS: 15 cm apart cross row spacing;30SRS-(IS): 30 cm apart single row spacing with increase seed rate: 30 CRS-(IS): 30 cm apart cross row spacing with increased seed rate

Sustainable weed management is only possible by completely understanding the weed-crop interference. Such understanding plays a critical and integrated weed control program. In our study, we observed that chemical weed control and 30 cm apart cross row spacing were statistically at par thus assuring that chemical weed control can be avoided by designing appropriate row spacing layout. Furthermore, adopting integrated practices can lead to sustainable land use, boosting agricultural productivity while maintaining ecological balance in the region (41). Herbicide usage can be substantially minimized by applying principles of biological and ecological weed control measures (42, 43).

CONCLUSION

This study demonstrates that cultural practices, particularly 30 cm cross-row spacing with increased seed rate, can effectively control weeds and enhance wheat yield. These findings are significant for resource-limited farmers seeking alternatives to herbicide use. Future research should explore the long-term effects of these practices on soil health and weed dynamics across diverse agro-climatic regions. It is assumed that planting geometry if managed properly can render beneficial results in managing weeds. This research is helpful to the farmers who cannot afford chemicals to control weeds; moreover the continuous suppression of weeds will render minimum reproduction of unwanted weeds by this method.

References:

1. Tahir T, Rasheed A, Kayani S, Shahzad A. High-throughput digital imaging analysis for grain morphology of historical wheat cultivars of Pakistan. Genetic Resources and Crop Evolution. 2024;71(6):2925-34.
2. Khan MA, Mohammad F. Effect of genotype× environment interaction on grain yield determinants in bread wheat. Sarhad J. Agric. 2018;34(1):54-62.
3. Hadasch S, Laidig F, Macholdt J, Bönecke E, Piepho HP. Trends in mean performance and stability of winter wheat and winter rye yields in a long-term series of variety trials. Field Crops Research. 2020;252:107792.
4. Dimitrov E, Uhr Z, Chipilski R. Study of yield and stability by common winter wheat varieties by changing climatic conditions in Sadovo region. Bulgarian Journal of Agricultural Science. 2022;28(2).
5. Hashim S, Jan A, Fahad S, Ali HH, Mushtaq MN, Laghari KB, Jabran K, Chauhan BS. Weed management and herbicide resistant weeds: a case study from wheat growing areas of Pakistan. Pakistan Journal of Botany. 2019;51(5):1761-7.
6. Ullah H, Khan N, Khan IA. Complementing cultural weed control with plant allelopathy: Implications for improved weed management in wheat crop. Acta Ecologica Sinica. 2023;43(1):27-33.
7. Korres NE. Agronomic weed control: A trustworthy approach for sustainable weed management. InNon-chemical weed control. Academic Press. 2018:97-114.
8. De Cauwer B, Delanote L, Devos M, De Ryck S, Reheul D. Optimisation of weed control in organic processing spinach (Spinacia oleracea L.): Impacts of cultivar, seeding rate, plant spacing and integrated weed management strategy. Agronomy. 2020;11(1):53.
9. Kanatas PJ, Gazoulis I. The integration of increased seeding rates, mechanical weed control and herbicide application for weed management in chickpea (Cicer arietinum L.). Phytoparasitica. 2022;50(1):255-67.
10. Kaleri AA, Sadiq M, Jamali A, Ullah Z, Musawwir A, Islam M, Sadiqa A, Kakar K, Manzoor D, Adil S. Effects of Phosphorus Application Rate on the Growth and Yield of Wheat (Triticum Aestivum L.). Pak-Euro Journal of Medical and Life Sciences. 2024;7(2):151-8.
11. Borger CP, Hashem A, Powles SB. Manipulating crop row orientation and crop density to suppress Lolium rigidum. Weed Research. 2016;56(1):22-30.
12. Hashim S, Rab A, Nawab K. Weed control effects on the wheat-pea intercropping. Pak. J. Bot. 2013;45(5):1743-8.
13. Hozayn M, El-Shahawy TA, Sharara FA. Implication of crop row orientation and row spacing for controlling weeds and increasing yield in wheat. 2012: 422-427.
14. Travlos IS. Reduced herbicide rates for an effective weed control in competitive wheat cultivars.
15. Mehmood, Z., Ashiq, M., Noorka, I. R., Ali, A., Tabasum, S., & Iqbal, M. S. (2014). Chemical control of monocot weeds in wheat (Triticum aestivum L.). American Journal of Plant Sciences, 2014.
16. Zimdahl RL. Weed-crop competition: a review. 2007.
17. Chauhan BS. Grand challenges in weed management. Frontiers in Agronomy. 2020;1:3.
18. Swanton CJ, Nkoa R, Blackshaw RE. Experimental methods for crop–weed competition studies. Weed Science. 2015;63(SP1):2-11.
19. Madurapperuma SJ, Amaratunga D, Haigh R. Disasters, climate change and development nexus: Food security sector in Asia. InMulti-Hazard early warning and disaster risks. Springer International Publishing. 2021:111-126.
20. Adnan S, Ullah K, Gao S, Khosa AH, Wang Z. Shifting of agro-climatic zones, their drought vulnerability, and precipitation and temperature trends in Pakistan. International Journal of Climatology. 2017;37:529-43.
21. Fniguire F, Laftouhi NE, Saidi ME, Zamrane Z, El Himer H, Khalil N. Spatial and temporal analysis of the drought vulnerability and risks over eight decades in a semi-arid region (Tensift basin: Morocco). Theoretical and Applied Climatology. 2017;130:321-30.
22. Chandrasekara SS, Kwon HH, Vithanage M, Obeysekera J, Kim TW. Drought in South Asia: A review of drought assessment and prediction in South Asian countries. Atmosphere. 2021;12(3):369.
23. Khattak WA, Sun J, Hameed R, Zaman F, Abbas A, Khan KA, Elboueghdiri N, Akbar R, He F, Ullah MW, Al-Andal A. Unveiling the resistance of native weed communities: insights for managing invasive weed species in disturbed environments. Biological Reviews. 202499(3):753-77.

24. Abbas T, Nadeem MA, Tanveer A, Matloob A, Farooq N, Burgos NA, Chauhan BS. Confirmation of resistance in littleseed canarygrass (Phalaris minor retz) to accase inhibitors in central Punjab-Pakistan and alternative herbicides for its management. Pak. J. Bot. 2017;49(4):1501-7.
25. Holt JS. Plant responses to light: a potential tool for weed management. Weed Science. 1995;43(3):474-82.
26. Bàrberi P. Ecological weed management in sub-Saharan Africa: prospects and implications on other agroecosystem services. Advances in Agronomy. 2019 Jan 1;156:219-64.
27. Kristensen L, Olsen J, Weiner J. Crop density, sowing pattern, and nitrogen fertilization effects on weed suppression and yield in spring wheat. Weed science. 2008;56(1):97-102.
28. Mashingaidze AB, Van Der Werf W, Lotz LA, Chipomho J, Kropff MJ. Narrow rows reduce biomass and seed production of weeds and increase maize yield. Annals of Applied Biology. 2009;155(2):207-18.
29. Chauhan BS, Johnson DE. Weedy rice (Oryza sativa) I. Grain characteristics and growth response to competition of weedy rice variants from five Asian countries. Weed Science. 2010;58(4):374-80.
30. Khaliq A, Matloob A, Chauhan BS. Weed management in dry-seeded fine rice under varying row spacing in the rice-wheat system of Punjab, Pakistan. Plant production science. 2014;17(4):321-32.
31. Weiner J, Griepentrog HW, Kristensen L. Suppression of weeds by spring wheat Triticum aestivum increases with crop density and spatial uniformity. Journal of applied ecology. 2001:784-90.
32. Guillemin JP, Gardarin A, Granger S, Reibel C, Munier-Jolain N, Colbach N. Assessing potential germination period of weeds with base temperatures and base water potentials. Weed Research. 2013;53(1):76-87.
33. Kolb LN, Gallandt ER, Molloy T. Improving weed management in organic spring barley: physical weed control vs. interspecific competition. Weed Research. 2010;50(6):597-605.
34. Reddy KN. Broadleaf weed control in ultra narrow row bromoxynil-resistant cotton (Gossypium hirsutum). Weed Technology. 2001;15(3):497-504.
35. Shinggu CP, Dadari SA, Shebayan JA, Adekpe DI, Mahadi MA, Mukhtar A, Asala SW. Influence of spacing and seed rate on weed suppression in finger millet (Eleucine carocana gaertn). Middle-East Journal of Scientific Research. 2009;4(4):267-70.
36. Grichar WJ, Besler BA, Brewer KD. Effect of row spacing and herbicide dose on weed control and grain sorghum yield. Crop protection. 2004;23(3):263-7.
37. Hock SM, Knezevic SZ, Martin AR, Lindquist JL. Soybean row spacing and weed emergence time influence weed competitiveness and competitive indices. Weed Science. 2006;54(1):38-46.
38. Shrestha A, Fidelibus M. Grapevine row orientation affects light environment, growth, and development of black nightshade (Solanum nigrum). Weed science. 2005 Dec;53(6):802-12.
39. Lemerle D, Lockley P, Koetz E, Diffey S. Herbicide efficacy for control of annual ryegrass (Lolium rigidum Gaud.) is influenced more by wheat seeding rate than row spacing. Crop and Pasture Science. 2013;64(7):708-15.
40. Fahad S, Hussain S, Chauhan BS, Saud S, Wu C, Hassan S, Tanveer M, Jan A, Huang J. Weed growth and crop yield loss in wheat as influenced by row spacing and weed emergence times. Crop Protection. 2015;71:101-8.
41. Khan I, Arif U, Baloch MS, Imtiaz MT, Ullah H, Akhtar MA, Shahzad MF, Jaffar H, Mahmood MT, Khan AU, Ullah G. An Insight to Integrated Farming System Impacts on Soil Physiography and Weed Control in South Waziristan. Pak-Euro Journal of Medical and Life Sciences. 2024;7(2):159-68.
42. Chauhan BS, Mahajan G, Sardana V, Timsina J, Jat ML. Productivity and sustainability of the rice–wheat cropping system in the Indo-Gangetic Plains of the Indian subcontinent: problems, opportunities, and strategies. Advances in agronomy. 2012;117:315-69.
43. Hussain S, Khaliq A, Matloob A, Fahad S, Tanveer A. Interference and economic threshold level of little seed canary grass in wheat under different sowing times. Environmental Science and Pollution Research. 2015;22:441-9.