Archives of Current Research International

Volume 25, Issue 6, Page 487-494, 2025; Article no.ACRI.138443
ISSN: 2454-7077

Influence of Agronomic Practices on Growth and Yield of Chickpea (*Cicer arietinum* L.)

Khemendra Choudhary [a*], Amarjeet [b], Parveen Kumar [a], Rohtas Kumar [c], Chander Shekhar [d], Rajendra Singh Beniwal [e] and Pradeep Kumar [f]

[a] Department of Agronomy, CCS Haryana Agricultural University, Hisar-125004, (Haryana), India.
[b] Department of Agronomy, Regional Research Station, Bawal, CCS Haryana Agricultural University, Hisar-125004, (Haryana), India.
[c] Department of Soil Science, CCS Haryana Agricultural University, Hisar-125004, (Haryana), India.
[d] Department of Agricultural Meteorology, CCS Haryana Agricultural University, Hisar-125004, (Haryana), India.
[e] Department of Forestry, CCS Haryana Agricultural University, Hisar-125004, (Haryana), India.
[f] Krishi Vigyan Kendra, Khunti, ICAR-NISA, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/acri/2025/v25i61293

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/138443

Original Research Article

Received: 15/04/2025
Accepted: 20/06/2025
Published: 21/06/2025

ABSTRACT

Weed management is a critical aspect of chickpea (*Cicer arietinum* L.) cultivation, influencing its growth and yield potential. As one of the leading pulse crops cultivated globally, chickpea faces significant challenges from weed competition, which can severely hinder crop development by

**Corresponding author: Email: khemendrachoudhary18@gmail.com;*

Cite as: *Choudhary, Khemendra, Amarjeet, Parveen Kumar, Rohtas Kumar, Chander Shekhar, Rajendra Singh Beniwal, and Pradeep Kumar. 2025. "Influence of Agronomic Practices on Growth and Yield of Chickpea (Cicer Arietinum L.)". Archives of Current Research International 25 (6):487-94. https://doi.org/10.9734/acri/2025/v25i61293.*

competing for vital resources such as light, water, and nutrients. The study investigated the impact of various crop establishment methods and weed management practices on the growth and yield of chickpea (*Cicer arietinum* L.) over two consecutive *rabi* seasons (2022–23 and 2023–24) at the regional research station, Bawal, CCS Haryana Agricultural University, Hisar. The experiment was laid out using a split-plot design, consisting of 30 treatment combinations comprising six crop establishment methods, viz. E_1- Normal row spacing under zero tillage (45-45 cm), E_2- Paired row spacing under zero tillage (30:60 cm), E_3- Normal row spacing under conventional tillage, E_4- Paired row spacing under conventional tillage, E_5- Normal row spacing under bed planting and E_6- Paired row spacing under bed planting in main plot and five weed management treatments are W_1- Pendimethalin 30% EC (1000 g/ha at pre-emergence), W_2- Pendimethalin 30% EC (1000 g/ha at pre-emergence) + one hand weeding at 25-30 DAS, W_3- Two hand weeing at 25-30 and 45-50 DAS, W_4- Weedy check and W_5- Weed free in subplot. Each treatment combination was replicated three times. Results indicated that bed planting with normal row spacing significantly improved leaf area index (LAI) and seed yield, achieving maximum LAI values of 1.649 and 1.714 and seed yields of 1675.8 and 1760.7 kg ha^{-1} in 2022-23 and 2023-24, respectively. Among weed management treatments, weed-free plots and those managed by two hand weeding (25-30 and 45-50 DAS) consistently outperformed others, reflecting significantly higher LAI and grain yields.

Keywords: Bed planting; leaf area index; weed free; hand weeding; yield; chickpea.

1. INTRODUCTION

The establishment of crops significantly affects their performance, with methods such as zero tillage and bed planting particularly influencing growth and yield outcomes in chickpea (*Cicer arietinum* L.) production systems. Zero tillage, a conservation agriculture practice, entails planting seeds directly into an untilled soil surface, preserving soil structure and enhancing moisture retention (Zhou *et al.,* 2021). This method has been shown to improve soil health by increasing organic matter content, decreasing compaction, and facilitating better water infiltration and retention (He *et al.,* 2011 and Alam *et al.,* 2014 and Angon *et al.,* 2023). Crops grown under zero tillage practices often exhibit increased crop yields due to reduced moisture loss and enhanced nutrient availability, particularly in regions with limited water resources (Dhaliwal *et al.,* 2021 and Zhou *et al.,* 2021). Among the crop nutrients, nitrogen stands out for its pivotal role in plant growth and development. Consequently, adopting foliar application of nutrients emerges as a more efficient strategy than traditional fertilization methods. Foliar fertilization involves directly spraying or applying liquid or water-soluble fertilizers onto plant leaves, facilitating rapid nutrient absorption by bypassing the soil uptake pathway. This supplementary feeding approach proves particularly beneficial during periods of nutrient deficiencies, stress, or accelerated growth, ensuring timely nutrient delivery to support plant health and productivity (Rolaniya et al., 2024). In contrast, bed planting, which involves growing crops in raised beds with specific row spacing, optimizes resource use by improving drainage and increasing soil temperature at the root zone. This method encourages better airflow, reduces weed pressure through planned crop arrangements, and enhances water use efficiency (Keil *et al.,* 2020). Additionally, achieving suitable row spacing in bed planting allows for adequate sunlight penetration, which is essential for optimal photosynthesis and chlorophyll production (Mukherjee *et al.,* 2023). Well-managed bed planting can lead to higher chickpea yields by facilitating better management of water and nutrients while reducing competition from weeds. Both zero tillage and bed planting are significant in improving crop productivity and sustainability. These practices not only enhance soil quality and health but also contribute to efficient water management and minimize environmental impacts, thereby playing a critical role in sustainable agricultural practices for chickpea cultivation and other crops (Kumar *et al.,* 2024).

Weed management is a critical aspect of chickpea (*Cicer arietinum* L.) cultivation, influencing its growth and yield potential. As one of the leading pulse crops cultivated globally, chickpea faces significant challenges from weed competition, which can severely hinder crop development by competing for vital resources such as light, water, and nutrients (Singh *et al.,* 2020). Weeds, particularly aggressive species, can overshadow chickpea plants, inhibiting photosynthesis and growth, which can lead to considerable yield losses (Tanveer *et al.,* 2015).

The timing and frequency of weed control measures play vital roles in the productivity of chickpea, particularly during the early growth stages when competition is most acute (Singh & Jain, 2017). Integrating various weed management practices, including mechanical, biological, and chemical methods, can provide a synergistic effect to suppress weed populations and reduce their impact on chickpea yield (Singh *et al.,* 2020). Effective weed management not only enhances chickpea growth attributes but also contributes to improving soil health and the overall agroecosystem (Mohammadkhani *et al.,* 2023). In light of the increasing demand for chickpeas in global markets, establishing effective weed management protocols that are tailored to local conditions is essential for enhancing productivity and economic viability in chickpea farming. Moreover, the choice of establishment methods, such as zero tillage and bed planting, can also impact weed management efficacy. These methods influence the soil environment, thus affecting weed emergence and growth patterns, creating an opportunity to improve chickpea productivity through smarter management strategies (Priya *et al.,* 2020).

2. MATERIALS AND METHODS

The present study was carried out over two consecutive *rabi* seasons (2022-23 and 2023-24) Regional Research Station, Bawal, of Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana. The experiment was laid out using a split-plot design, consisting of 30 treatment combinations comprising six crop establishment methods, viz. E_1- Normal row spacing under zero tillage (45-45 cm), E_2- Paired row spacing under zero tillage (30:60 cm), E_3- Normal row spacing under conventional tillage, E_4- Paired row spacing under conventional tillage, E_5- Normal row spacing under bed planting and E_6- Paired row spacing under bed planting in main plot and five weed management treatments are W_1- Pendimethalin 30% EC (1000 g/ha at pre-emergence), W_2- Pendimethalin 30% EC (1000 g/ha at pre-emergence) + one hand weeding at 25-30 DAS, W_3- Two hand weeing at 25-30 and 45-50 DAS, W_4- Weedy check and W_5- Weed free in subplot. Each treatment combination was replicated three times.

the soil of the experimental field was loamy sand in texture and slightly alkaline in soil reaction with low in available nitrogen, micronutrient (Fe, Cu, Zn, & Mn) and organic carbon and medium in available phosphorus and available potassium A standardized basal dose of fertilizers, 20 kg ha^{-1} nitrogen, 40 kg ha^{-1} phosphorous applied through DAP and 25 kg ha^{-1} zinc were applied through ZnSO4 at the time of preparation of field. Pre-emergence herbicide pendimethalin were sprayed on next day of sowing of chickpea. Herbicide were sprayed using battery operated knapsack sprayer and flat fan nozzle having 15 litre tank capacity. For spraying of herbicide, 500 litres of water per hectare was used. Weed free plots were kept free from weeds by hand weeding. One hand weeding were done at 30 DAS and two hand weeding were done at 30 and 50 DAS with the help of hand hoe. Weeding were done as per schedule to maintain recommended spacing and proper weed free environment. Data collected during the study were statistically analyzed by using the technique of analysis of variance (ANOVA) as applicable to Split plot design (Gomez & Gomez, 1984). The significance of the treatment effects was determined using F-test at 5 % probability.

3 RESULTS AND DISCUSSION

3.1 Leaf Area Index (LAI)

The data on leaf area index (LAI) of chickpea crops as influenced by different establishment methods and weed management practices during 2022-23 and 2023-24 are presented in Table 1. Analysis of the data revealed that the LAI was significantly influenced by both establishment methods and weed management practices, particularly at 60, 90 and 120 DAS in both years. Among the establishment methods, normal row spacing under bed planting (E_5) resulted in the highest LAI, with values of 0.874, 1.385 and 1.649 at 60, 90 and 120 DAS, respectively, during 2022-23, and 0.980, 1.531 and 1.714 during 2023-24. This was followed closely by Paired row spacing under bed planting (E_6), which recorded values of 0.845, 1.332 and 1.572 at the respective growth stages during 2022-23 and 0.942, 1.515 and 1.698 during 2023-24. The leaf area index (LAI) serves as an indicator of a genotype's metabolic capacity and its efficiency in utilizing available resources. It is defined as the ratio of the total leaf surface area of a crop to the land area it covers. Although LAI is often characteristic of a specific variety, it can fluctuate based on the plant's genetic traits, nutrient availability, and prevailing environmental conditions throughout the growing season. Bed planting facilitates ideal plant density and spacing compared to conventional planting. This

controlled environment allows for better light interception, reduced competition among plants, and ultimately leads to greater leaf area development The inter-row management under bed planting helps minimize shading within the crop canopy, facilitating higher photosynthetic activity which is essential for LAI expansion. The results also get support from the findings of Chala *et al.,* (2020), Kumar *et al.,* (2024) and Rasheed *et al.,* (2024).

In terms of weed management practices, the weed-free (W_5) treatment exhibited the highest LAI at 60, 90 and 120 DAS in both years, with values of 0.942, 1.532 and 1.790 during 2022-23 and 1.101, 1.736 and 1.919 during 2023-24. The two HW at 25-30 and 45-50 DAS (W_3) treatment also performed well, with values of 0.918, 1.464, and 1.714 at the respective growth stages during 2022-23 and 1.015, 1.626 and 1.809 during 2023-24. On the other hand, the weedy check (W_4) had the lowest LAI across the board, particularly during the critical stages of growth like 60, 90 and 120 DAS, reflecting the detrimental effects of uncontrolled weed competition on chickpea growth. Hand weeding minimizes weed competition, which is particularly important during critical growth stages of chickpea. Weed interference can significantly diminish leaf area due to competition for resources, indicating that effective weed control through methods such as hand weeding can enhance plant health and increase LAI. The results also get support from the findings of (Ghanizadeh *et al.,* (2014), Dey *et al.,* (2017); and Sharma and Jadhav (2024)

3.2 Seed Yield (kg/ha)

The data pertaining to the grain yield of chickpea as affected by different establishment methods and weed management practices are presented in Table 2. The analysis of variance revealed that the grain yield of chickpea was significantly influenced by the method of crop establishment. Among the various methods tested, normal row spacing under bed planting (1675 and 1760 kg ha^{-1}) recorded the highest seed yield, which was found statistically at par with the paired row spacing under bed planting method (1638 and 1701 kg ha^{-1}). In contrast, the lowest seed yield was observed in the treatment involving paired row spacing under zero tillage (E_2). Normal row spacing in bed planting is the maximization of light interception and photosynthesis. Adequate spacing reduces interplant competition for light, leading to a greater number of effective branches and pods per plant, which directly correlates with yield increases. The arrangement of plants in bed planting systems also enables better moisture conservation and minimizes water stress during critical growth periods. Normal row spacing within these beds allows for optimal growth conditions during flowering and pod development stages, which are essential for yield formation. Chickpea plants grown under adequate spacing can achieve higher seed yields due to better resource management and reduced weed competition, which is often intensified in narrow row setups. The results also get support from the findings of Gupta *et al.,* (2022), Gezahegn et al., (2022) and Hammami *et al.* (2025).

With respect to weed management practices, there was a pronounced effect on chickpea grain yield across both years of the study. The weed-free treatment (W_5) consistently produced the highest grain yield, indicating the importance of complete and timely weed control in realizing the yield potential of the crop. Following this, the treatment involving two hand weeding (HW) at 25-30 and 45-50 DAS also resulted in significantly higher grain yields, recording 1744.8 and 1838.7 kg ha-1 during the first and second year, respectively. This method proved to be equally effective as the chemical control treatment comprising pendimethalin 30% EC at 1000 g ha^{-1} as a pre-emergence herbicide (PRE) followed by one HW at 25-30 DAS (1662 and 1745 kg ha-1). On the other hand, the weedy check, where no weed control measures were undertaken, resulted in the lowest grain yield in both years. The timing and frequency of hand weeding play an essential role in weed management and yield enhancement. Specifically, the timing of two hand weeding (at 25-30 DAS and 45-50 DAS) coincides with critical growth stages for chickpeas. Effective weed control during these growth periods can maximize crop growth and minimize weed seed bank re-establishment. Effective weed control during crucial stages reduces weed interference, which can inhibit plant height, pod formation, and seed filling. By employing hand weeding at strategic growth intervals, the competitive advantage of weeds is effectively reduced, allowing for improved growth metrics such as pod number and seed size, subsequently enhancing overall yield. The results also get support from the findings of Frenda *et al.,* (2013) and Mohammed *et al.,* (2020).

Table 1. Effect of different establishment methods and weed management options on leaf area index of chickpea

Treatment		2022-23				2023-24			
		30 DAS	60 DAS	90 DAS	120 DAS	30 DAS	60 DAS	90 DAS	120 DAS
Establishment methods									
E_1	Normal row spacing under zero tillage (45 cm)	0.232	0.728	1.243	1.449	0.238	0.814	1.388	1.571
E_2	Paired row spacing under zero tillage (30:60 cm)	0.220	0.693	1.197	1.385	0.223	0.790	1.349	1.532
E_3	Normal row spacing under conventional tillage	0.255	0.805	1.274	1.530	0.247	0.910	1.417	1.600
E_4	Paired row spacing under conventional tillage	0.247	0.787	1.236	1.492	0.241	0.881	1.372	1.555
E_5	Normal row spacing under bed planting	0.291	0.874	1.385	1.649	0.277	0.980	1.531	1.714
E_6	Paired row spacing under bed planting	0.276	0.845	1.332	1.572	0.285	0.942	1.515	1.698
SE(m)±		0.022	0.013	0.032	0.024	0.019	0.015	0.026	0.020
CD at 5%		NS	0.038	0.087	0.069	NS	0.046	0.074	0.061
Weed management practices									
W_1	Pendimethalin 30% EC (1000 g/ha) PRE	0.263	0.703	1.131	1.363	0.268	0.762	1.267	1.450
W_2	Pendimethalin 30% EC (1000 g/ha) PRE + one HW at 25-30DAS	0.276	0.855	1.376	1.615	0.273	0.960	1.543	1.707
W_3	Two HW at 25-30 and 45-50 DAS	0.251	0.918	1.464	1.714	0.234	1.015	1.626	1.809
W_4	Weedy check	0.233	0.525	0.885	1.082	0.215	0.594	0.991	1.174
W_5	Weed free	0.245	0.942	1.532	1.790	0.270	1.101	1.736	1.919
SE(m)±		0.023	0.027	0.030	0.028	0.023	0.030	0.030	0.027
CD at 5%		NS	0.082	0.091	0.085	NS	0.084	0.087	0.081

Table 2. Effect of different establishment methods and weed management options on seed yield of chickpea

Treatment		2022-23	2023-24
		Seed yield (kg ha^{-1})	Seed yield (kg ha^{-1})
Establishment methods			
E_1	Normal row spacing under zero tillage (45 cm)	1383.1	1450.1
E_2	Paired row spacing under zero tillage (30:60 cm)	1340.9	1385.8
E_3	Normal row spacing under conventional tillage	1530.2	1610.7
E_4	Paired row spacing under conventional tillage	1474.8	1548.8
E_5	Normal row spacing under bed planting	1675.8	1760.7
E_6	Paired row spacing under bed planting	1638.7	1701.3
SE(m)±		27.8	30.4
CD at 5%		87.6	95.8
Weed management practices			
W_1	Pendimethalin 30% EC (1000 g/ha) PRE	1277.1	1329.6
W_2	Pendimethalin 30% EC (1000 g/ha) PRE + one HW at 25-30DAS	1662.5	1745.7
W_3	Two HW at 25-30 and 45-50 DAS	1744.8	1838.7
W_4	Weedy check	1021.8	1040.8
W_5	Weed free	1830.0	1926.4
SE(m)±		35.3	38.5
CD at 5%		100.3	109.6

4. CONCLUSION

On the basis of two year experimentation, it can be concluded that chickpea should be grown on bed planting with normal row spacing showed significantly better crop growth, maximum grain yield. Applying two-hand weeding at 25-30 and 45-50 DAS provided better crop growth and significantly higher grain yield of chickpea.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Alam, M. K., Islam, M. M., Salahin, N., & Hasanuzzaman, M. (2014). Effect of tillage practices on soil properties and crop productivity in wheat-mungbean-rice cropping system under subtropical climatic conditions. *The scientific world journal*, *(1),* 437283

Angon, P. B., Anjum, N., Akter, M. M., KC, S., Suma, R. P., & Jannat, S. (2023). An overview of the impact of tillage and cropping systems on soil health in agricultural practices. *Advances in Agriculture*, *(1),* 8861216.

Chala, B., Abera, T., & Nandeshwar, B. (2020). Influence of inter and intra row spacing on yield and yield components of chickpea (*Cicer arietinum* L.) in Jimma Horro District, Western Ethiopia. *International Journal of Plant & Soil Science, 32(15),* 32-42.

Dey, S. K., Chakrabarti, B., Prasanna, R., Singh, S. D., Purakayastha, T. J., Datta, A., & Pathak, H. (2017). Productivity of mungbean (*Vigna radiata*) with elevated carbon dioxide at various phosphorus levels and cyanobacteria inoculation. *Legume Research-An International Journal, 40(3),* 497-505.

Dhaliwal, S. S., Sharma, S., Shukla, A. K., Sharma, V., Bhullar, M. S., Dhaliwal, T. K., & Hossain, A. (2021). Removal of biomass and nutrients by weeds and direct-seeded rice under conservation agriculture in light-textured soils of north-western India. *Plants*, *10*(11), 2431.

Frenda, A. S., Ruisi, P., Saia, S., Frangipane, B., Di Miceli, G., Amato, G., & Giambalvo, D. (2013). The critical period of weed control in faba bean and chickpea in Mediterranean areas. *Weed Science*, *61*(3), 452-459.

Gezahegn, A. M., Tafes, B., & Eshetu, S. (2022). Boosting chickpea production by optimizing inter-row and intrarow spacing at central highlands of Ethiopia. *International Journal of Agronomy*, *2022*(1), 4139645.

Ghanizadeh, H., Lorzadeh, S. H., & Aryannia, N. (2014). Effect of weed interference on *zea mays*: growth analysis. *Weed Biology and Management, 14(2),* 133-137.

Gupta, R., Basediya, A., & Asati, K. (2022). Performance evaluation of different seed bed configurations in chickpea cultivation in Malwa region of Madhya Pradesh, India. *Ecology, Environment and Conservation, 28(08),* S103-S107.

Hammami, I., Nouha, F., Toukabri, W., Msehli, W., Thouraya, B. H., Arwa, A., & Trabelsi, D. (2025). Effects of weed management on soil metagenomic composition in cultivated chickpea fields. *Environmental Research Communications, 7(1),* 015011.

He, J., Li, H., Rasaily, R. G., Wang, Q., Cai, G., Su, Y., & Liu, L. (2011). Soil properties and crop yields after 11 years of no tillage farming in wheat–maize cropping system in North China Plain. *Soil and Tillage Research*, *113*(1), 48-54.

Keil, A., Mitra, A., Mc Donald, A., & Malik, R. K. (2020). Zero-tillage wheat provides stable yield and economic benefits under diverse growing season climates in the Eastern Indo-Gangetic Plains. *International Journal of Agricultural Sustainability*, *18*(6), 567-593.

Kumar, B. R., & Angadi, S. S. (2016). Effect of tillage, mulching and weed management practices on the performance and economics of chickpea. *Legume Research-An International Journal*, *39*(5), 786-791.

Kumar, N., Sindhu, V. K., Sidhu, A. S., & Aulakh, C. S. (2024). Productivity and profitability of sesame (*Sesamum indicum*) - chickpea (*Cicer arietinum*) organic cropping system as influenced by nutrition and planting geometry. *The Indian Journal of Agricultural Sciences, 94(8),* 827-832.

Mohammadkhani, F., Pouryousef, M., Yousefi, A. R., & Gonzalez-Andujar, J. L. (2023). Weed community changes in saffron+ chickpea intercropping under different irrigation management. *Plos one*, *18(5),* e0286474.

Mohammed, Y. A., Miller, Z., Hubbel, K., & Chen, C. (2020). Variety and weed management effects on organic chickpea stand establishment and seed yield. *Agrosystems, Geosciences & Environment*, *3*(*1),* e20035.

Mukherjee, B., Kumar Naskar, M., Nath, R., Atta, K., Visha Kumari, V., Banerjee, P., & Hossain, A. (2023). Growth, nodulation, yield, nitrogen uptake, and economics of lentil as influenced by sowing time, tillage, and management practices. *Frontiers in Sustainable Food Systems*, *7*, 1151111.

Priya, M. V., Singh, T., Saini, K. S., & Singh, S. (2022). Production potential and economic returns of bed planted chickpea (*Cicer arietinum* l.) as influenced by different intercropping systems. *Legume Research-An International Journal*, *45(3),* 347-351.

Rasheed, M. U., Malik, A., & Ali, M. S. (2024). Genetic variation and heritability estimates in chickpea seedling traits: implications for breeding programs. *Bulletin of Biological and Allied Sciences Research, 2024(1),* 59-59.

Rolaniya, L. K., Jat, R. L., Kumar, N., Punia, M., & Choudhary, R. R. (2023). Effect of integrated nutrient management practices on growth and yield of chickpea under different chickpea-based cropping systems in Western Rajasthan, India. *International Journal of Environment and Climate Change*, 13(12), 1253–1259.

Sharma, C., & Jadhav, A. S. (2024). Investigation on the carry-over effects of various pre- and post-emergence herbicides applied alone and in combination to cotton on succeeding chickpea crop. *Journal of Experimental Agriculture International, 46(6),* 371-378.

Singh, A., & Jain, N. (2017). Integrated weed management in chickpea*. Indian Journal of Weed Science, 49(1),* 93.

Singh, A., Rana, S. S., & Bala, A. (2020). Weed management strategies in chickpea (*Cicer arietinum*): A Review. *Agricultural Reviews*, *41*(2), 153-159.

Tanveer, A., Javaid, M. M., Irfan, M., Khaliq, A., & Yaseen, M. (2015). Yield losses in chickpea with varying densities of dragon spurge (*Euphorbia dracunculoides*). *Weed Science*, *63*(2), 522-528.

Zhou, W., Rao, P., Jat, M., Singh, B., Poonia, S., Bijarniya, D., & Jain, M. (2021). Using sentinel-2 to track field-level tillage practices at regional scales in smallholder systems. *Remote Sensing, 13(24),* 5108.

Peer-review history:
The peer review history for this paper can be accessed here:
https://pr.sdiarticle5.com/review-history/138443