



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; 8(10): 637-643
Received: 22-08-2025
Accepted: 26-09-2025

Mamta J Jadav
Ph.D. Scholar, Department of Seed
Science and Technology, B. A.
College of Agriculture, Anand
Agricultural University, Anand,
Gujarat, India

Kalyanrao
Senior Scientist (Seed Science and
Technology), ICAR-National
Institute of Seed Science &
Technology, Mau, Uttar Pradesh,
India

NA Patel
Associat Research Scientist, Main
Rice Research Station, Anand
Agricultural University, Nawagam,
Gujarat, India

Dipak A Patel
I/c. Research Scientist and Unit
Officer, Department of
Agricultural Biotechnology, Centre
of Excellence in Biotechnology,
Anand Agricultural University,
Anand, Gujarat, India

KM Bera
Ph. D. Scholar, Department of
Seed Science and Technology, B. A.
College of Agriculture, Anand
Agricultural University, Anand,
Gujarat, India

Corresponding Author:

Mamta J Jadav
Ph.D. Scholar, Department of Seed
Science and Technology, B. A.
College of Agriculture, Anand
Agricultural University, Anand,
Gujarat, India

Innovative approaches to standardize seed production for maximizing yield in chilli (*Capsicum annuum*) var.

Anand Tej

Mamta J Jadav, Kalyanrao, NA Patel, Dipak A Patel and KM Bera

DOI: <https://www.doi.org/10.33545/2618060X.2025.v8.i10i.4040>

Abstract

A field study was conducted at Anand Agricultural University (AAU), Anand, during the 2023–25 seasons to standardize the transplanting date, fruit harvesting stage, and post-harvest ripening period for optimizing seed yield in *Capsicum annuum* var. Anand Tej. The experiment comprised 18 treatment combinations involving two transplanting dates (1st week of September and October), three fruit harvesting stages (170, 200 and 230 days after transplanting), and three post-harvest ripening durations (10, 20 and 30 days after harvest), arranged in a factorial randomized block design. Results revealed that transplanting in the first week of September significantly enhanced key yield parameters, including fruit weight, fruit length, plant height, number of fruits per plant, number of seeds per fruit, seed weight per fruit, seed weight per plant, and 1000-seed weight. Harvesting fruits at 200 days after transplanting followed by a 20-day post-harvest ripening period consistently produced the highest seed yield and quality. Therefore, early transplanting (first week of September), harvesting at 200 days, and a 20-day ripening period are recommended as an integrated strategy for maximizing seed yield and quality in chilli variety Anand Tej.

Keywords: Mirchi, date of transplanting, fruit harvesting stages, post harvest ripening period, seed yield and crop growth

Introduction

Chilli (*Capsicum annuum* L.) is a commercially important vegetable-cum-spice crop in India, cultivated for both domestic use and export. It is valued for its green fruits as a vegetable and red fruits as a spice. Belonging to the family *Solanaceae* with a diploid chromosome number of $2n = 24$, chilli is believed to have originated in South and Central America. The genus *Capsicum* includes 27 species, of which five—*C. annuum*, *C. frutescens*, *C. chinense*, *C. baccatum*, and *C. pubescens*—are domesticated (Bosland, 1993) [9]. The name "Capsicum" is derived from the Greek word *kapsimo*, meaning "to burn." The pungency in chilli is due to capsaicin ($C_{18}H_{27}NO_3$), while the red color is attributed to capsanthin. *C. annuum* is an annual sub-shrub bearing pendent fruits, including types like red pepper, cayenne, paprika, and bell pepper. *C. frutescens* is a perennial type with small, highly pungent fruits, commonly known as bird chilli or Tabasco.

India leads in chilli production, consumption, and export, contributing over 40% to global dry chilli output (Anonymous, 2025) [6]. In 2025, it produced 32.08 lakh tonnes from 9.90 lakh hectares (3,240 kg/ha). Andhra Pradesh tops production, followed by Telangana, Madhya Pradesh, and Karnataka. Gujarat, with stable output, produced 36,128 tonnes from 14,059 hectares, with Gondal (Rajkot) reaching 2,380 kg/ha. 'Naga Jolokia', the world's hottest chilli, is cultivated in Tezpur, Assam. Chilli is an essential spice in Indian cuisine, valued for its pungency, colour, and aroma. Dry chillies are widely used in cooking and processing, offering nutritional and medicinal benefits. Capsaicin, found mainly in the placenta and seeds, gives pungency and has anti-cancer and heart-protective properties (Bosland & Votava, 2000; Hoffman *et al.*, 1983) [8, 15]. Chillies are classified as pungent (hot) or non-pungent (sweet) and are rich in vitamins A, C, E, folic acid, and minerals. Chilli thrives in diverse climates and soils, preferring well-drained soils with pH 5.5–6.5. Though moderately salt-tolerant, salinity hampers germination and seedling vigour. Sowing is commonly done in August. Optimal fruit set occurs

at 16–20 °C, and 24–30 °C favours fruit development. Temperatures above 33 °C reduce fruit set and colour. The crop is sensitive to excess moisture and heavy rainfall.

Optimum sowing date is critical for maximizing crop yield, as it influences growth, disease incidence, and productivity. Earlier planting generally enhances stand establishment and yield. Islam *et al.* (2010) [18] reported improved growth and yield in sweet pepper with early sowing, while Bevacqua and Vanleeuwen (2003) [7] found the highest yield associated with the earliest planting dates. The seed yield is maximum during the physiological maturity stage. Prolonged field exposure after its maturity was result in reduction in yield and loss of viability and vigour of the seed after harvest (McAlister, 1943, Enguchi *et al.*, 1958) [22, 10]. Constitution of seeds extracted from fruits at different maturity stages is likely to differ due to differential supply and accumulation of food reserves in the seeds. Similarly, post harvest ripening of fruits may influence seed quality because even after the fruits are harvested from mother plant, there will be continuous development of immature and mature embryos. Increase in fruit ripening period is known to increase seed weight in chilli (Quagliotti *et al.*, 1981) [30] and also increase seed yield and quality in chilli (Radheshyam *et al.*, 1996 and Vinodkumar *et al.*, 2002) [31, 35]. The research works pertaining to the stage of fruit harvest and post harvest ripening period is very limited and thus it requires systematic studies to get maximum quantity of high quality seeds in chilli. To find out the effect of different date of transplanting, different stages of harvesting and post-harvest ripening period on seed yield of chilli.

Materials and Methods

The present investigation was carried out during the *Kharif-Rabi* seasons of 2023–24 and 2024–25 at the Regional Research Station and Main Vegetable Research Station, Anand Agricultural University, Anand, Gujarat, respectively.

The experiment was conducted using chilli variety Anand Tej under field. The Gujarat Anand Vegetable Chilli 141 (Anand Tej) seeds were acquired from the, Main Vegetable Research Station, Anand Agricultural University. The experimental field's soil was sandy loam, also known as “Goradu soil” of “charotar” tract. It is alluvial in nature, deep and well-drained and fairly moisture retentive. Plant spacing was 60 cm between plants and 60 cm between rows. The experimental field had an even topography with gentle slope and good drainage. The soil responds well to manuring, irrigation and is suitable for growing variety of crops of the tropical and sub-tropical region.

The field experiment was structured in a Factorial Randomized Block Design (FRBD) with three factors, each at different levels. The first factor, transplanting time (Factor I), included two levels: S₁ – transplanting in the first week of September and S₂ – transplanting in the first week of October. The second factor, days to fruit harvesting (Factor II), had three levels based on the number of days after transplanting: H₁ – 170 days, H₂ – 200 days, and H₃ – 230 days after transplanting. The third factor, post-harvest ripening period (Factor III), was studied at three durations: P₁ – 10 days after harvest, P₂ – 20 days after harvest, and P₃ – 30 days after harvest. This factorial combination allowed for the evaluation of individual and interactive effects of transplanting time, fruit harvest timing, and ripening duration on seed yield parameters in chilli (*Capsicum annum* L.) var. Anand Tej.

Results and Discussion

Following parameters were recorded during the course of study:

Fruit weight (g), Fruit length (cm), Plant height (cm), Number of fruits plant⁻¹, Number of seeds fruit⁻¹, Seed yield fruit⁻¹(g), Seed yield plant⁻¹ (g) and 1000 seed weight were measured.

The combined effects of transplanting date, harvesting stage and post-harvest ripening duration had a significant impact on seed weight per fruit (Fig. e) and seed weight per plant (Fig. f) in the aggregated data analysis. Significantly maximum seed weight per plant (36.44 g) in first date of transplanting (1st week of September) with fruit harvest at H₂ stage (200 days) for seed subjected in 20 days of post harvest ripening period whereas, significantly minimum seed weight per plant (11.34 g) recorded by second date of transplanting (1st week of October) with fruit harvest at H₁ stage (170 days) for 10 days post harvest ripening period on pooled basis. Chilli plants harvested at 200 days after transplanting (early September), followed by a 20-day post-harvest ripening period, showed the highest seed weight per plant. This increase is attributed to the synchronization of reproductive stages with favorable agro-environmental factors, including a stable microclimate, residual soil moisture, and optimal evaporative demand, which enhance vegetative growth, flowering, and seed development. The extended growth period allowed physiological maturity, improving source-sink efficiency and dry matter partitioning. Post-harvest ripening promoted seed filling through continued metabolic processes such as enzyme activity, sugar accumulation, and protein synthesis, enhancing seed biomass and viability. Given chilli's indeterminate flowering habit, precise harvest timing ensures uniform seed maturity and minimizes losses from fruit drop, pest infestation, and climatic stress. These results are supported by earlier studies in chilli and bell/sweet pepper (Vinodkumar *et al.*, 2002; Hunje *et al.*, 2006; Manjunatha *et al.*, 2009; Alam *et al.*, 2011; Mends-Cole *et al.*, 2019; Yaragal, 2023) [35, 17, 21, 4, 23, 36]. Significantly maximum seed weight per fruit (0.55 g) in first date of transplanting (1st week of September) with fruit harvest at H₂ stage (200 days) for seed subjected in 20 days of post harvest ripening period whereas, significantly minimum seed weight per fruit (0.32 g) recorded by second date of transplanting (1st week of October) with fruit harvest at H₁ stage (170 days) for 10 days post harvest ripening period on pooled basis. Maximum seed weight per fruit was observed when chilli fruits were harvested at 200 DAT (first week of September) and ripened for 20 days post-harvest. This improvement is attributed to the alignment of reproductive stages with favorable agro-climatic conditions—moderate temperatures, residual soil moisture, and optimal humidity—promoting full physiological maturity and effective assimilate translocation. Post-harvest ripening enhanced seed development through continued nutrient flow and key biochemical changes, including increased enzyme activity, sugar accumulation, and storage protein synthesis. This approach also reduced losses from fruit drop, pest damage, and environmental stress. The results are consistent with earlier findings in chilli and sweet/bell pepper by Alam *et al.* (2011) [4], Hamma *et al.* (2012) [12], Mends-Cole *et al.* (2019) [23].

According to the observations, the highest fruit weight (1.88 g) was recorded in first date of transplanting (1st week of September) with fruit harvest at H₂ stage (200 days) for 20 days of post harvest ripening period whereas, numerically lowest fruit weight (1.18 g) recorded by second date of transplanting (1st week of October) with fruit harvest at H₁ stage (170 days) for 10 days post harvest ripening period on pooled basis (Fig. a). Fruit weight is a key yield determinant in chilli, reflecting genetic potential and environmental adaptability. In this study, early transplanting (S₁) consistently produced higher fruit weight due to favorable temperature, solar radiation, and soil moisture,

which enhanced photosynthesis and assimilate partitioning. Maximum weight at 200 days after fruit set was linked to prolonged maturation under optimal conditions, allowing greater dry matter accumulation and cell enlargement. Early transplanting extended the reproductive phase, aligning fruit growth with favorable conditions, improving both fruit weight and seed quality, consistent with earlier reports. Chilli's indeterminate and asynchronous flowering necessitates harvesting at physiological maturity (deep red coloration), which corresponds to maximum dry matter accumulation and cell enlargement, directly influencing fruit size and weight (Manjunatha *et al.*, 2009; Hunje *et al.*, 2006; Ahmed *et al.*, 2008).^[21, 17, 21] Early transplanting also extends the reproductive phase, aligning critical stages of fruit growth with favorable environmental conditions, thereby enhancing photosynthate allocation to developing fruits and seeds (Moirangthem *et al.*, 2012; Mahmud *et al.*, 2017)^[24, 20]. This synergistic effect improves both fruit weight and seed quality, corroborating earlier findings (Pandita & Nagarajan, 2001; Oladitan, 2017; 2024; Vidigal *et al.*, 2011)^[28, 26, 34]. However, numerically higher fruit length was recorded with the first date of transplanting (1st week of September), when fruits were harvested at the H₂ stage (200 days after transplanting) and subjected to a 20-day post-harvest ripening period, registering 11.68 cm while, the lowest fruit length was observed with the second date of transplanting (1st week of October), fruit harvested at the H₁ stage (170 days after transplanting) and 10-day post-harvest ripening period, with values 7.99 cm on pooled analysis (Fig. b). Fruit length in chilli was highest with early transplanting (S₁) due to favorable climatic conditions enhancing photosynthesis and assimilate flow, promoting cell expansion. Maximum length at 200 days after transplanting resulted from prolonged maturation under moderate temperatures and adequate moisture, allowing fruits to reach their genetic size potential. These results align with previous findings that link early planting and extended growth duration with enhanced fruit development in chilli (Alam *et al.*, 2011; Islam, 2010; Hamma *et al.*, 2012; Akter *et al.*, 2017; Mends-Cole *et al.*, 2019; Pritam *et al.*, 2024)^[4, 19, 12, 3, 23, 29].

In terms of values, highest plant height (73.90 cm) were recorded in first date of transplanting (1st week of September) with fruit harvest at H₂ stage (200 days) for 20 days of post harvest ripening period whereas, numerically lowest plant height (59.29 cm) recorded by second date of transplanting (1st week of October) with fruit harvest at H₁ stage (170 days) for 10 days post harvest ripening period on pooled basis (Fig. g). Plant height in chilli is significantly influenced by environmental conditions prevailing during vegetative and reproductive growth. In this study, the earliest transplanting date (S₁) resulted in greater plant height, likely due to favorable agro-climatic factors such as well-distributed rainfall, moderate temperatures, and higher relative humidity. These conditions are known to enhance photosynthetic efficiency and vegetative vigor, thereby supporting overall plant elongation. These observations are consistent with earlier reports highlighting the role of seasonal variation in influencing plant architecture in chilli (Moirangthem *et al.*, 2012; Saqib & Anjum, 2021; Haytova, 2022; Abeer *et al.*, 2024)^[24, 32, 14, 11]. Numerically maximum 1000 seed weight (6.05 g) in first date of transplanting (1st week of September) with fruit harvest at H₂ stage (200 days) for seed subjected in 20 days of post harvest ripening period whereas, numerically minimum 1000 seed weight (5.00 g) recorded by second date of transplanting (1st week of October) with fruit harvest at H₁ stage (170 days) for 10 days post harvest ripening period on pooled

basis (Fig. h). A higher 1000-seed weight was observed under the earliest transplanting date (S₁), likely due to favorable environmental conditions during key developmental phases. Harvesting at 200 days after transplanting, coupled with a 20-day post-harvest ripening period, resulted in the highest test weight. This is attributed to advanced physiological maturity and prolonged assimilate translocation, supporting maximum dry matter accumulation in seeds (Zhang *et al.*, 2019). Biochemical activities such as increased enzyme function and assimilate accumulation during post-harvest ripening significantly enhanced seed filling and quality. Timely harvesting minimized biotic and abiotic stress-related losses. The fully matured dark red stage was identified as optimal for maximizing seed biomass and quality in paprika-type chilli, consistent with findings by Pamela *et al.* (2020)^[27], Venkat (2018)^[33], Nagaraj *et al.* (2015)^[25], Hullur *et al.* (2015)^[16], Alan and Eser (2008)^[15], Ahmed *et al.* (2008)^[2] and Vinodkumar *et al.* (2002)^[35].

The numerically maximum number of fruit per plant was recorded with the first date of transplanting (1st week of September), fruit harvesting after 200 days and a 20-day post-harvest ripening period, with values of 64.20 on the pooled analysis. Numerically, the minimum number of fruit per plant was observed with the second date of transplanting (1st week of October), fruit harvesting after 170 days and a 10-day post-harvest ripening period, recording values of 33.24 on the pooled analysis (Fig. c). The number of fruits per plant is a vital yield attribute in chilli and is highly influenced by seasonal dynamics. In the present study, a significantly higher fruit count was recorded under the earliest transplanting date (S₁), which may be attributed to the advantageous growing conditions during the early stages of development. These included a stable thermal regime, favorable soil moisture levels, and less atmospheric stress, which collectively supported vigorous vegetative growth, enhanced floral initiation, and successful fruit set. Transplanting in the first week of September also resulted in an extended crop duration, allowing more time for the plant to undergo multiple flowering cycles and complete fruit development. Moreover, this early schedule helped the crop escape late-season pest pressures and environmental fluctuations. The combination of early sowing and delayed harvesting at 200 days ensured uniform physiological maturity, more efficient resource allocation, and increased carbohydrate deposition in developing fruits, thereby improving fruit number, seed filling, and overall seed vigour. These observations are consistent with previous studies by Islam (2010)^[18], Alam *et al.* (2011)^[4], Akter *et al.* (2017)^[3], Ghose *et al.* (2017)^[11], Hayati *et al.* (2020)^[13] which support the beneficial role of early transplanting and prolonged maturity in enhancing fruit yield and seed quality in chilli. Numerically maximum number of seeds per fruit (85.30) in first date of transplanting (1st week of September) with fruit harvest at H₂ stage (200 days) for seed subjected in 20 days of post harvest ripening period whereas, numerically minimum number of seeds per fruit (42.25) recorded by second date of transplanting (1st week of October) with fruit harvest at H₁ stage (170 days) for 10 days post harvest ripening period on pooled basis (Fig. d). Harvesting at 200 DAT (first week of September) resulted in the highest seed count per fruit. This stage likely coincided with favorable agro-climatic factors such as optimal temperature range, sufficient residual soil moisture, and a supportive vapor pressure deficit, promoting full fruit development and seed set. Due to the indeterminate flowering habit of chilli, fruit maturation is asynchronous. However, harvesting near physiological maturity, followed by controlled post-harvest ripening, enhances assimilate translocation, improving seed

filling and viability. Timely harvesting also minimizes exposure to biotic and abiotic stresses that can impair seed quality. In paprika-type chillies, limited studies have assessed the combined effects of harvest timing and ripening on seed traits. These findings are in agreement with previous reports by Hamma *et al.* (2012)^[12], Mends-Cole *et al.* (2019)^[23] and Manjunatha *et al.* (2009)^[21]. The analysis revealed that transplanting date, harvesting stage, and post-harvest ripening duration exerted a significant influence individually on plant height, 1000-seed weight, fruit weight, fruit length, number of fruits per plant, and number of seeds per fruit. However, their combined interaction showed a stable response, indicating that while each factor independently contributed to variation in these traits, the

interaction among them had minimal influence on overall growth and yield performance in chilli.

The present investigation on *Capsicum annuum* var. Anand Tej demonstrated that strategic standardization of seed production practices—through the integration of optimum transplanting time, fruit harvest stages, and post-harvest ripening period—significantly influenced key seed yield. Thus, early transplanting (September), harvesting at physiological maturity (200 DAT), and a 20-day ripening period post-harvest are key to maximizing seed yield and quality in chilli (*Capsicum annuum*) var. Anand Tej. Adoption of this integrated approach offers a practical and agronomically sound strategy for seed standardization and commercial seed production in chilli.

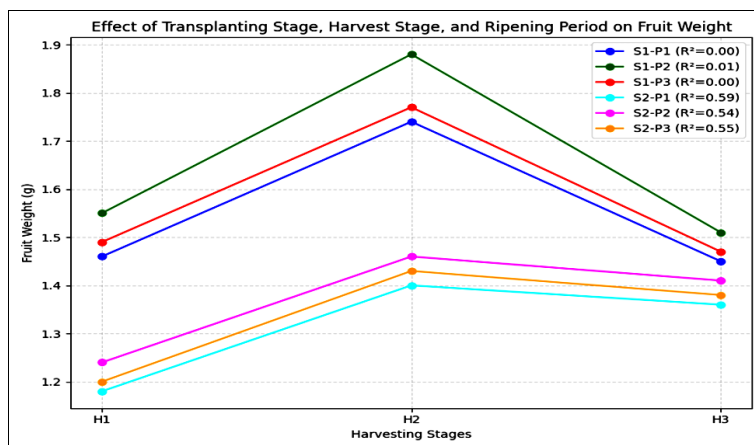


Fig a: Effect of date of transplanting, days to fruit harvesting and post harvest ripening period on fruit weight (g)

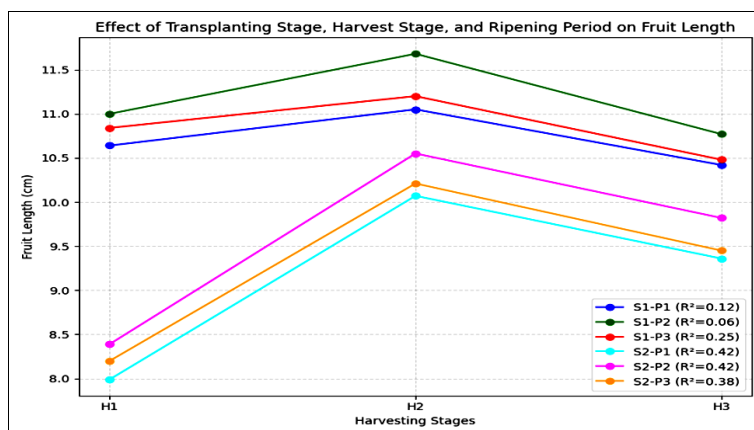


Fig b: Effect of date of transplanting, days to fruit harvesting and post harvest ripening period on fruit length (cm)

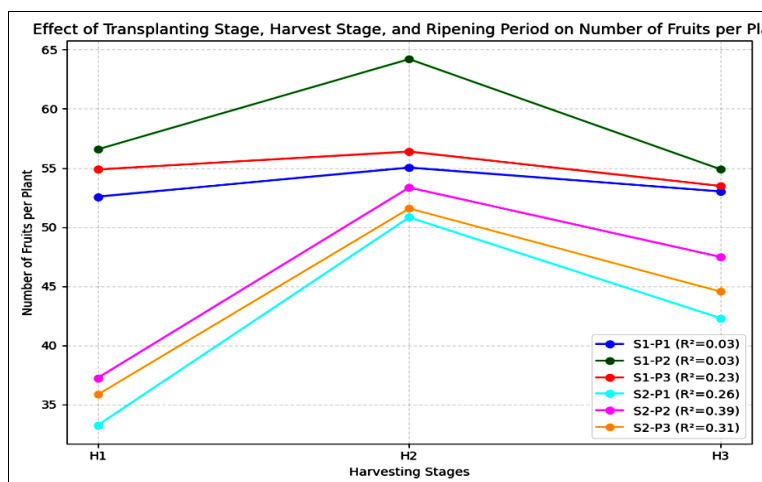


Fig c: Effect of date of transplanting, days to fruit harvesting and post harvest ripening period on number of fruit per plant

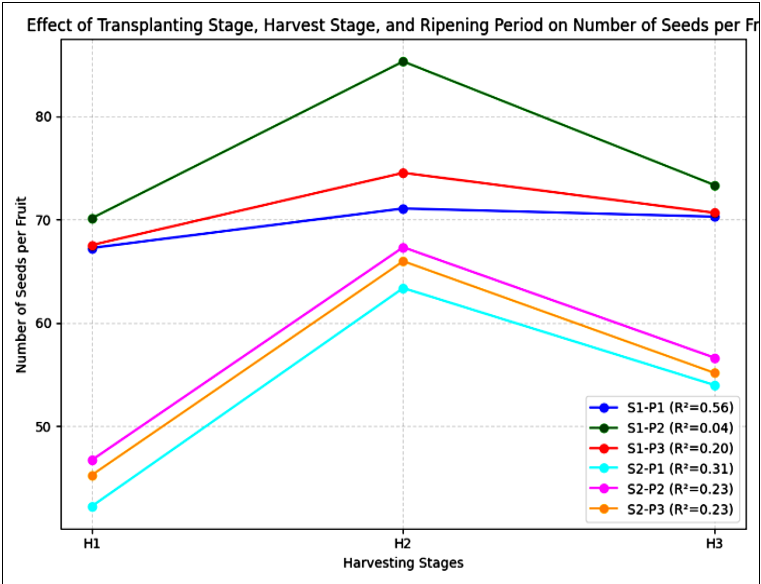


Fig d: Effect of date of transplanting, days to fruit harvesting and post harvest ripening period on number of seed per fruit

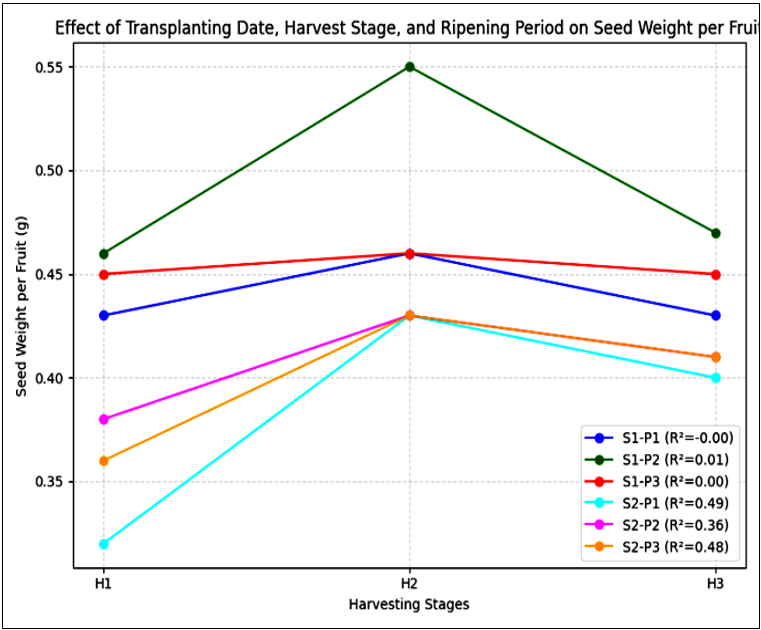


Fig e: Effect of date of transplanting, days to fruit harvesting and post harvest ripening period on seed weight per fruit (g)

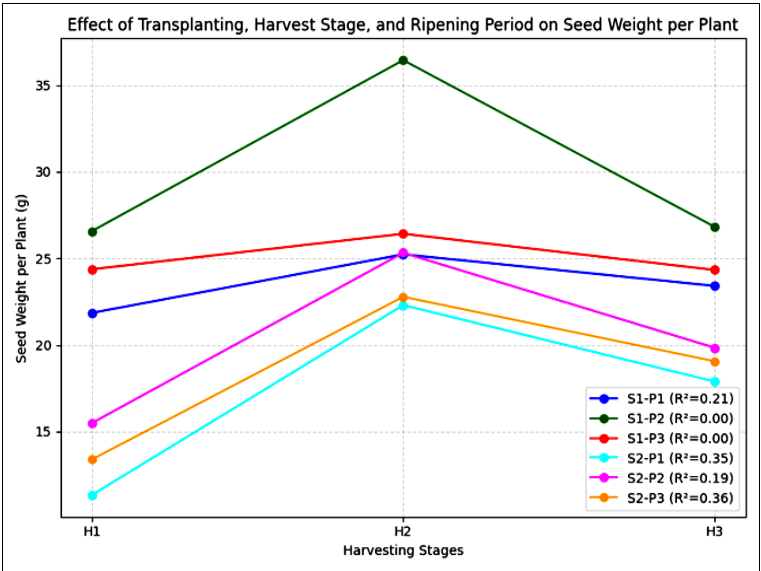


Fig f: Effect of date of transplanting, days to fruit harvesting and post harvest ripening period on seed weight per plant (g)

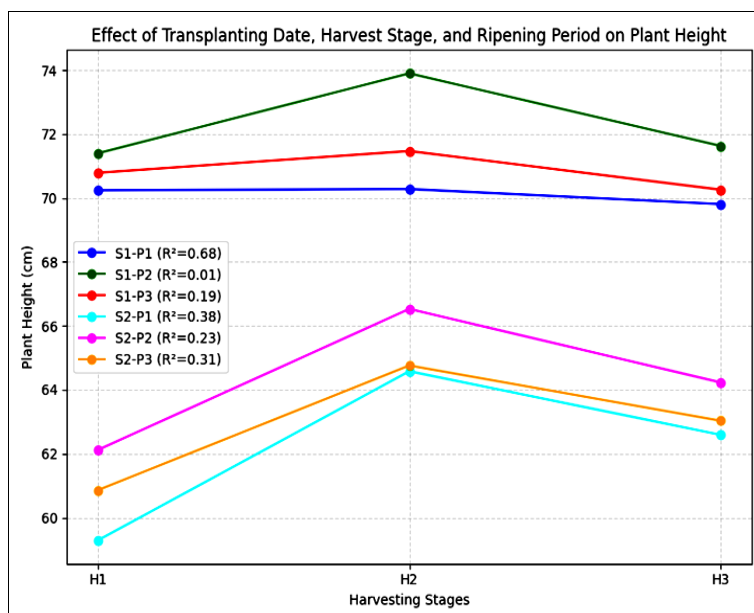


Fig g: Effect of date of transplanting, days to fruit harvesting and post harvest ripening period on plant height (cm)

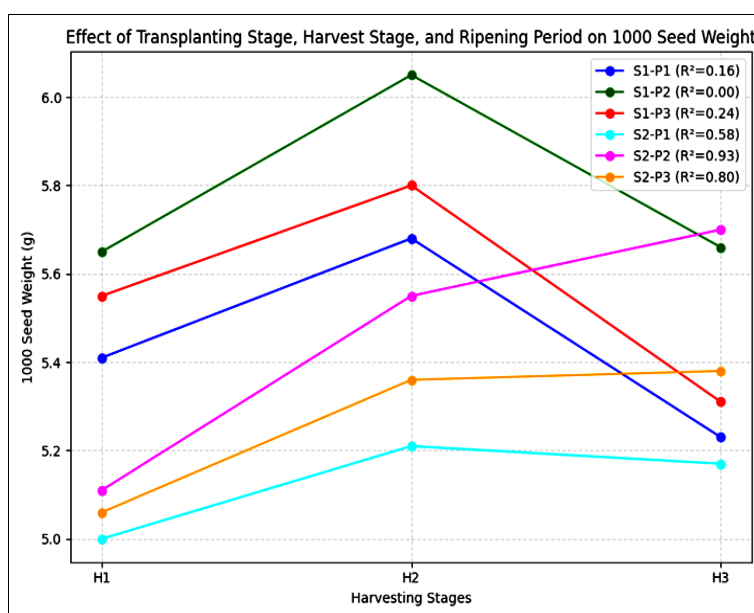


Fig h: Effect of date of transplanting, days to fruit harvesting and post harvest ripening period on 1000 seed weight (g)

Acknowledgement

The authors express their sincere gratitude to Anand Agricultural University for providing the necessary facilities and institutional support. They also gratefully acknowledge the financial assistance received from the Department of Education, Government of Gujarat, which was instrumental in the successful execution of this research work.

References

1. Abeer SW, Khalid AS, Ayman RM, Sayed G. Impact of planting dates on pepper (*Capsicum annum* L.) genotypes performance and stability under Qena governorate conditions. *J Sohag Agrisci*. 2024;9:212-33.
2. Ahmed AMS, Shantappa T, Merwade MN, Gangadarappa PM, Devappa V. Influence of stages of fruit harvest and post harvest ripening periods on seed quality in paprika chilli (*Capsicum annum* L.). *Karnataka J Agric Sci*. 2008;20:266-9.
3. Akter L, Ali MR, Hasan T, Halim GMA, Mehraj H. Effect of planting time and seedling raising methods on growth and yield of capsicum. *Pak J Agric Sci*. 2017;7:179-84.
4. Alam MS, Saha SR, Salam MA, Alam MS, Alam MK. Effect of sowing time and plant spacing on the yield and yield attributes of sweet pepper. *Bangladesh J Agric Res*. 2011;36:271-8.
5. Alan O, Eser B. The effect of fruit maturity and post-harvest ripening on seed quality in hot and conic pepper cultivars. *Seed Sci Technol*. 2008;36:467-74.
6. Anonymous. Agriculture at a glance. 2025. Available from: <http://eands.dacnet.nic.in>.
7. Bevacqua RF, Vanleeuwen DM. Planting date effects on stand establishment and yield of chilli pepper. *J Am Soc Hortic Sci*. 2003;38:357-65.
8. Bosland PW, Votava EJ. Peppers: vegetable and spice capsicums. CABI Publishing; 2000. p. 1-16.
9. Bosland PW. Breeding for quality in *Capsicum*. *Newslett*. 1993;12:25-31.
10. Enguchi J, Maleamara T, Ashiawa N. Effect of nutrition on

- flower formation in vegetable crops. Proc Am Soc Hortic Sci. 1958;72:343-52.
11. Ghose M, Bhattacharya S, Mandal SK. Effect of date of planting on pest and leaf curl virus incidence on bell pepper (*Capsicum annuum* L.) in the Bengal basin. J Entomol Zool Stud. 2017;5:507-10.
 12. Hamma IL, Ibrahim U, Haruna M. Effect of planting date and spacing on the growth and yield of sweet pepper in Samaru area of Zaria in Nigeria. Niger J Agric Food Environ. 2012;8:63-6.
 13. Hayati PKD, Mandwi MY, Martinsyah RH, Sutoyo S. Fruit picking time and fruit characteristics of the F_2 population of local okra [*Abelmoschus esculentus* L. Moench] crosses with introduced variety. IOP Conf Ser Earth Environ Sci. 2020;7:41-2.
 14. Haytova D. Study on different cultivation dates of pepper as early field production. Balkan Agricultural Congress; 2022. p. 342-9.
 15. Hoffman PG, Lego MC, Galetto WG. Separation and quantitation of reds pepper major heat principles by reverse phase high performance liquid chromatography.¹ J Agric Food Chem. 1983;31:26-30.
 16. Hullur N, Devaraju, Radha PJ, Venkata Chalapathy BN. Influence of maturity stages and post-harvest ripening on seed quality in chilli genotypes. Int J Process Post-Harvest Technol. 2015;6:19-25.
 17. Hunje R, Vyakarnahal BS, Jagadeesha RC. Influence of fruit maturity on seed yield and its components in chilli. Karnataka J Agric Sci. 2006;20:496-500.
 18. Islam M. Influence of sowing date and spacing on growth and yield of sweet pepper [M.Sc. (Hort.) Thesis]. Sher-e-Bangla Agricultural University; 2010.
 19. Islam M, Saha S, Akand H, Rahim A. Effect of sowing date on the growth and yield of sweet pepper (*Capsicum annuum* L.). Agron Glas. 2010;1:3-13.
 20. Mahmud NU, Chakma R, Ahmed NU, Zaman MAU, Hossain A. Effect of sowing date on quality seed production of sweet pepper in Bangladesh. Prog Agric. 2017;28:216-21.
 21. Manjunatha KC, Yogeesh HS, Prasanna KPR. Influence of stage of fruit harvesting and post harvesting ripening on seed quality in bell pepper (*Capsicum annuum* L.). Mysore J Agric Sci. 2009;43:24-7.
 22. Mcalister DF. The effect of maturity on the viability and longevity of seeds on western range pasture grass. J Am Soc Agron. 1943;35:442-53.
 23. Mends-Cole MT, Banful B, Tandoh P. Seed quality responses of two chilli pepper varieties (*Capsicum frutescens* L.) to different planting dates. J Exp Agric Int. 2019;30:1-11.
 24. Moirangthem SS, Sailen G, Fiyaz RA, Ramya KT, Thongbam PD. Effect of planting time and spacing on growth characteristics of yellow lantern chilli (*Capsicum chinense*). Indian J Agric Sci. 2012;82:328-33.
 25. Nagaraj H, Devaraju, Radha PJ, Chalapathy VBN. Influence of maturity stages and post-harvest ripening on seed quality in chilli genotypes. Int J Process Post Harvest Technol. 2015;6:19-25.
 26. Oladitan TO. Growth and development of green pepper (*Capsicum annuum* L.) as influenced by planting dates and fertilizer application in Owo, South West Nigeria. Int J Hortic. 2017;7:262-74.
 27. Pamela GNF, Natalia DBL L, Priscilla NDL S, Estefania MB, Ana EBT, Marina TRC, et al. The physiological quality of 'chilli pepper' seeds, extracted from fruits harvested at different stages of maturation, with and without postharvest rest. Aust J Crop Sci. 2020;14:739-43.
 28. Pandita VK, Nagarajan S. Fruit maturity and post harvest ripening affecting chilli seed quality and field emergence. Seed Res. 2001;29:21-3.
 29. Pritam P, Gautam BP, Nayanmoni B, Goswami RK, Bora B. Effect of different growing media and sowing dates on seedling growth of bhut jolokia (*Capsicum chinense* Jacq.). Plant Arch. 2024;24:1479-88.
 30. Quagliotti L, Antonucci M, Lanteri S. Effects of post harvest ripening of the seeds within the berry in two varieties of pepper (*Capsicum annuum* L.). Adv Hortic Sci. 1981;65:249-56.
 31. Radheshyam, Arora SK, Pandita ML, Singh J. Effect of stage of fruit maturity at harvest on seed quality of chilli (*Capsicum annuum* L.) cultivars. Haryana Agric Univ J Res. 1996;26:195-8.
 32. Saqib M, Anjum MA. Mitigation of climate change effect in sweet pepper (*Capsicum annuum* L.) through adjustment of planting time. Pak J Agric Sci. 2021;58:919-27.
 33. Venkat D. Influence of stages of fruit harvest and post harvest ripening periods on seed quality in paprika chilli (*Capsicum annuum* L.). Karnataka J Agric Sci. 2018;21:266-9.
 34. Vidigal DS, Dias DCFS, Finger FL. Changes in seed quality during fruit maturation of sweet pepper. Sci Agric. 2011;68:535-9.
 35. Vinodkumar, Shashidhar SD, Kurdikeri MB, Channaveerswami AS, Hosmani RM. Influence of harvesting stages on seed yield and quality in paprika (*Capsicum annuum* L.). Seed Res. 2002;30:99-103.
 36. Yaragal SS. Influence of stages of harvesting and seed extraction methods on seed yield and quality of paprika chilli (*Capsicum annuum* L.). University of Agricultural Sciences Bangalore; 2023.