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EFFECT OF PRIMING TREATMENTS ON SEED YIELD AND ITS ATTRIBUTING CHARACTERS OF KABULI CHICKPEA (*CICER ARIETINUM* L.)

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ABSTRACT

Chickpea is one of the most important pulse crops globally, renowned for its rich nutrient profile. Kabuli chickpea differs from desi one due to many reasons. Germination and yield of kabuli chickpea is low as compare to desi type. Seed priming is important technique to deal with all these problems. Seeds were primed with different chemicals before sowing. Experimental material was sown in Factorial Randomized Block Design (FRBD) with three replications with a spacing of 45 × 10 cm. The variety Phule G-16318 exhibited superior performance, recording a higher number of pods per plant (65.14) and seed yield per plant (26.23 g) compared to the varieties Virat and Kripa. However, Kripa demonstrated a higher seed index (50.95 g), attributed to its bold seed type. Seed treatments, particularly with sodium nitroprusside (SNP) at 25 ppm combined with Vitavax at 0.25% (T3), followed by potassium nitrate (KNO3) at 100 ppm and Vitavax at 0.25% (T7), were effective in significantly increasing the number of pods per plant (63.28), seed index (46.22 g), and seed yield per plant (27.85 g). Among the treatment interactions, Phule G-16318 primed with SNP at 25 ppm + Vitavax 0.25% (T3) followed by KNO3 at 100 ppm + Vitavax 0.25% (T7) produced the highest seed yield per plant (29.03 g), largely due to an increase in the number of pods per plant (18.83). These results highlight the potential of seed priming techniques to enhance chickpea productivity.

***Keywords* :** Chickpea, seed yield, priming and pods per plant.

Introduction

Pulses, alongside staples like rice and wheat, are an essential part of the human diet. They contribute significantly to food security and, more importantly, to nutrition security, particularly for low-income consumers who rely on plant-based protein sources. As pulse crops have the potential to enhance ecosystem resilience, reduce poverty and hunger, and promote better health and nutrition (Joshi & Rao, 2017), their value remains underappreciated. Recognizing this, the United Nations General Assembly designated 2016 as the International Year of Pulses to raise awareness of their nutritional benefits and their contribution to soil health and the ecosystem (Calles *et al*., 2019).

The main pulses grown in India include lentil (*Lens culinaris*), chickpea (*Cicer arietinum*), pigeonpea or red gram (*Cajanus cajan*), urdbean or black gram (*Vigna mungo*), and mungbean or green gram (*Vigna radiata*) (Agarwal & Yadav, 2017). Of these, chickpea holds significant global importance due to its versatile applications. In terms of production, it ranks third among pulses, following beans (Merga & Haji, 2019).

The chickpea (*Cicer arietinum* L.) is a self-pollinating pulse crop with diploid genome (2n = 16). Chickpea is a nutrient-rich food source. This annual pulse crop is primarily grown and consumed for its high-quality, easily digestible protein content (17–31 %) present in its seeds, which also provide substantial amounts of essential amino acids, including leucine, isoleucine, lysine, valine, and phenylalanine (Wang *et al.*, 2018). Chickpea is cultivated worldwide, predominantly in semi-arid tropical regions such as Australia, the Middle East, North Africa, Southern Europe, the Indian subcontinent, and the Americas. Globally, chickpea ranks third among pulse crops, covering an area of approximately 14.81 million hectares, with a production of 18.09 million tons and an average productivity of 850 kg ha^{-1} (FAO STAT, 2022). In India, it is grown on about 10.74 million hectares, producing 13.54 million tons with a productivity of 1261 kg ha^{-1}. In the state of Maharashtra alone, chickpea is cultivated on 29.25 lakh hectares, yielding 29.74 lakh tons with a productivity of 1013 kg ha^{-1} (India STAT, 2022).

Mainly there are two types of chickpea species, such as Desi and Kabuli type. Among desi and kabuli chickpea, desi chickpea has small seed, dark coloured thick seed coat. It has proper germination rate and optimum crop stand. Whereas kabuli chickpea have bigger seed size, unpigmented thin seed coat. Conversely kabuli chickpea has lower germination rate, which ultimately results in low crop stand in the field. Furthermore, kabuli chickpea takes prolonged time for germination. This lower germination of kabuli chickpea is due to its bigger size and variation in respiratory metabolism (Pandey *et al.* 2019).

Seed priming is important technique in seed technology which improves the germination, field stand, and also improves the yield. Seed priming is a pre-sowing technique where seeds are soaked in water or a chemical solution to trigger the initial stages of germination. This method boosts seed vigor, enhances germination rates, and promotes more uniform and vigorous seedling growth. Additionally, primed seeds tend to demonstrate greater stress tolerance and yield improvements compared to non-primed seeds (Nawaz *et al.* 2013). With keeping this view, the present investigation entitled, “Effect of priming treatments on seed yield and its attributing characters of kabuli chickpea (*Cicer arietinum* L.)” to improve the seed yield of chickpea.

Materials and Methods

Experiment site

The present investigation was carried out at Post Graduate Institute Research Farm, Department of Agricultural Botany, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (M.S.) during *Rabi* 2021-22 and 2022-23.

Experimental material

Three varieties of Kabuli chickpea (Kripa, Virat and Phule G-16318) used for the present investigation were obtained from Principal Scientist, Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri.

Details of priming treatments

The details of priming treatments and variety × treatment combinations (Table 1) used for given experiment is mentioned below:

1) T1 - Control
2) T2 - Sodium Nitroprusside (SNP) @ 25 ppm
3) T3 - Sodium Nitroprusside (SNP) @ 25 ppm+ Vitavax0.25%
4) T4 - Potassium nitrite (KNO2) @ 50 ppm
5) T5 - Potassium nitrite (KNO2) @ 50 ppm + Vitavax 0.25%
6) T6 - Potassium nitrate (KNO3) @ 100 ppm
7) T7 - Potassium nitrate (KNO3) @ 100 ppm + Vitavax 0.25%
8) T8 - Calcium chloride (CaCl2) @ 2%
9) T9 - Calcium chloride (CaCl2) @ 2% + Vitavax 0.25%
10) T10 - Salicylic acid @ 10 ppm
11) T11 - Salicylic acid @ 10 ppm + Vitavax 0.25%
12) T12 - Vitavax @ 0.25%

Table 1 : Variety × Treatment combinations

V1T1	V1T2	V1T3	V1T4	V1T5	V1T6	V1T7	V1T8	V1T9	V1T10	V1T11	V1T12
V2T1	V2T2	V2T3	V2T4	V2T5	V2T6	V2T7	V2T8	V2T9	V2T10	V2T11	V2T12
V3T1	V3T2	V3T3	V3T4	V3T5	V3T6	V3T7	V3T8	V3T9	V3T10	V3T11	V3T12

Methodology

The experiment was conducted in Factorial Randomized Block Design (FRBD) with three replications with a spacing of 45 × 10 cm and plot size of 3.00 × 2.70 m^2 in field condition. For seed priming chickpea seeds was soaked in different chemical solutions having different concentrations with fungicide vitavax and soaked in water for 4 hours. The treated seeds were surface dried back to the original moisture content. Untreated seeds were considered as control (Ali and Kamel, 2009). Observations were recorded on five randomly selected plants from each plot in each replication and mean were calculated. Observations were recorded on number of pods per plant, seed index and seed yield per plant. The experimental data obtained from field FRBD (Factorial Randomized Block Design) were analyzed as per the procedure given by Panse and Sukhatme (1995).

Results and Discussion

The effects of different priming treatments on different characters were presented under the following subheadings:

1) Number of pods per plant

Table 2 represents the data on number of pods per plant as influenced by different varieties (V), treatments (T) and their interactions are presented in Table 2 (a).

a) Effect of varieties

From the Table 2, it was seen that the number of pods per plant showed significant difference due to varieties. Among varieties, significantly maximum number of pods per plant 65.97, 64.31 and 65.14 was recorded by Phule G-16318 (V_3) and followed by Virat (V_2) as 61.11, 60.39 and 60.75 and the minimum number of pods per plant 51.28, 49.06 and 50.17 was recorded by Kripa (V_1) during the year 2021-22, 2022-23 and on pooled basis respectively, irrespective of treatments.

b) Effect of treatments

Seed priming treatments showed significant differences for number of pods per plant in both years and on pooled basis in the year 2021-22 and 2022-23. From the Table 2, it was found that the seed primed with sodium nitroprusside (SNP) @ 25 ppm + vitavax 0.25% (T_3) recorded significantly more number of pods per plant as 63.89, 62.67 and 63.28 followed by potassium nitrate (KNO_3) @ 100 ppm + Vitavax 0.25% (T_7) as 62.56, 60.89 and 61.72 respectively. However, less number of pods per plant was recorded in control (T_1) as 54.44, 52.33 and 53.39 in the year 2021-22, 2022-23 and on pooled basis respectively, irrespective of varieties.

c) Effect of interaction

The data pertaining in Table 2 (a), it was seen that the interaction effects of varieties (V) and treatments (T) on number of pods per plant of kabuli chickpea was found significant in both years and on pooled basis. Among the interaction effect of varieties and priming treatments (V × T) the interaction of V_3T_3 recorded significantly highest number of pods per plant as 69.67, 68.67 and 69.17 followed by interaction V_3T_7 recorded as 68.67, 67.00 and 67.83. Whereas, the lowest number of pods per plant were recorded in interaction V_1T_1 as 45.00, 43.67 and 44.33 in the year 2021-22, 2022-23 and on pooled basis, respectively. All morphological and yield contributing characters increased at all stages with SNP in chickpea this may be due to the ratio of auxins to cytokinins primarily controls the growth of lateral buds; a high ratio favors apical dominance. The actions of formerly recognized plant hormones have been closely associated with nitric oxide action in plants. It is known that cytokinins can cause the synthesis of NO in plants. The effects of SNP treatment appear to be the consequence of changes in hormone levels during critical developmental stages, which may initiate a number of metabolic processes to support the development of the reproductive system in chickpea (Chohan *et al.,* 2011).

2) Seed index (g)

The data regarding seed index (g) as influenced by varieties, seed priming treatments and their interaction are presented in Table 2 and 2 (a).

a) Effect of varieties

The results revealed that there was a significant difference among the chickpea varieties in both years and on pooled basis (Table 2). The variety Kripa (V_1) had significantly maximum seed index 51.21, 50.68 and 50.95 (g) followed by Phule G 16318 (V_3) 40.58, 40.50 and 40.54 (g) whereas, minimum seed index was recorded in Virat (V_2) as 36.97, 36.84 and 36.90 in the year 2021-22, 2022-23 and on pooled basis, respectively irrespective of seed priming treatments.

b) Effect of seed priming treatments

Seed priming treatments showed significant differences for seed index in both years and on pooled basis in Table 2. From the data, it was found that the seed treated with a sodium nitroprusside (SNP) @ 25 ppm + vitavax 0.25% (T_3) recorded significant higher seed index as 46.51, 45.94 and 46.22 (g) followed by potassium nitrate (KNO_3) @100 ppm + vitavax 0.25% (T_7) as 44.62, 44.17 and 44.40 (g) in the year 2021-22, 2022-23 and on pooled basis, respectively. However, lower seed index was recorded in control (T_1) as 39.76, 39.17 and 39.46 (g) during 2021-22, 2022-23 and on pooled basis, respectively irrespective of varieties.

c) Interaction effect

From the data, it was resulted that the interaction effects of varieties and priming treatments on seed index (g) of kabuli chickpea were significantly in both years on pooled basis are presented in Table 2 (a).

Among the interaction (V × T), the interaction V_1T_3 recorded significantly highest seed index as 56.67, 54.47 and 55.57 (g) followed by interaction V_1T_7 recorded as 53.80, 52.33 and 53.07 (g) in the year 2021-22, 2022-23 and on pooled basis, respectively. However, the lowest seed index recorded in interaction V_2T_1 as 34.27, 34.00 and 34.13 (g) in the year 2021-22, 2022-23 and on pooled basis, respectively. Treatments with sodium nitroprusside improved the amount of dry matter accumulated overall and its distribution among the various plant sections. The increased dry matter accumulation in the seeds of chickpea plants treated with SNP indicates that the source: sink ratio has changed as a result of this chemical. The efficient transport of photoassimilates from source (leaves) to sink (seeds) was enhanced by nitric oxide (Chohan *et al.,* 2011)

3) Seed yield per plant

In table 3 and 3 (a) presents information on the seed yield per plant (g) as influenced by varieties, treatments and their interactions are shown.

a) Effect of varieties on seed yield per plant (g)

According to the data (Table 3) the seed yield per plant revealed substantial differences related to the chickpea varieties in both seasons. The variety Phule G 16318 (V_3) had a considerably greater seed yield per plant as 26.43, 26.02 and 26.23 (g) and 25.09, 24.22 and 24.65 (g) followed by Kripa (V_1) and lowest in Virat (V_2) as 23.94, 22.41 and 23.18 (g) during *Rabi* 2021-22, 2022-23 and on pooled basis respectively with independent of priming treatments.

b) Effect of priming treatments on seed yield per plant (g)

Due to priming treatments during both seasons and regardless of variety, the information presented in table 3, shows the seed yield per plant (g) revealed significant differences. According to the data, sodium nitroprusside (SNP) @ 25 ppm + vitavax 0.25% (T_3) recorded 28.20, 27.51 and 27.85 (g) seed yield per plant followed by the treatment potassium nitrate (KNO_3) @100 ppm + vitavax 0.25% (T_7) 26.80, 26.24 and 26.52 (g) seed yield per plant during *Rabi* 2021-22, 2022-23 and on pooled basis respectively. While minimum seed yield per plant was recorded in control (T_1) 22.11, 21.67 and 21.89 (g) during *Rabi* season 2021-22, 2022-23 and on pooled basis respectively with regardless of varieties.

c) Interaction effect of varieties and priming treatments on seed yield per plant (g)

It was determined from the data that the interaction of varieties and priming treatments on seed yield per plant (g) of kabuli chickpea was significant for both years as presented in Table 3 (a). The highest seed yield per plant (g) was recorded in the interaction of varieties and priming treatments (V × T) for *Rabi* 2021-22, 2022-23 and on pooled basis respectively in the interaction of V_3T_3 as 29.40, 28.67 and 29.03 (g) followed by interaction V_3T_7 as 28.47, 26.67 and 27.57 (g). The minimal seed yield per plant (g) was noted in interactions V_2T_1 as 20.73, 20.01 and 20.37 (g) for *Rabi* 2021-22, 2022-23 and on pooled basis respectively. Seed priming process is a physiological method that involves seed hydration and effective enough for enhancement of seed germination and yield under stressed and non-stressed conditions (Dawood, 2018). The highest dose of SNP (100 µM) remained effective in accelerating and modifying plant growth and yield by optimizing their biochemical and metabolic functioning in a salinity-prone environment. Therefore, it was recommended to use exogenous applications of SNP to obtain a better yield of lentils (Yasir *et al.,* 2021).

Conclusion

Seed priming has been regarded as a suitable and useful technology in increasing the seed yield and germination percentage of chickpea. The variety Phule G-16318 recorded higher number of pods per plant (65.14) and seed yield per plant (26.23 g) than other varieties *viz.*, Virat and Kripa. Whereas, the variety Kripa recorded higher seed index (50.95 g) because of its bold seed type. The seeds treated with sodium nitroprusside (SNP) @ 25 ppm + vitavax 0.25% (T3) followed by potassium nitrate (KNO3) @100 ppm + vitavax 0.25% (T7) were found effective in significantly higher number of pods per plant (63.28), seed index (46.22 g) and seed yield per plant (27.85 g). Among the interactions, the seeds of variety Phule G-16318 primed with sodium nitroprusside (SNP) @ 25 ppm + vitavax 0.25% (T3) followed by potassium nitrate (KNO3) @100 ppm + vitavax 0.25% (T7) were recorded significantly higher seed yield per plant (29.03 g) due to increase in number of pods per plant (18.83). Seed treatment with sodium nitroprusside (SNP) could be used as important chemical to increase the yield of kabuli chickpea.

Future prospects

Based on the above findings, it is concluded that, the seed priming studies need to be study at molecular level. It is essential to understand the physiological and biochemical processes associated with seed priming treatments and further research for studying changes associated at molecular level. Sodium nitroprusside could be used as a spray in field crops to examine the effect on crop growth, yield and against pathogen incidence.

Table 2 : Effect of varieties (V) and priming treatments (T) on number of pods per plant and seed index of kabuli chickpea.

	Number of pods plant^{-1}			**Seed index (g)**		
	2021-22	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**
Varieties (V)						
V_1 – Kripa	51.28	49.06	50.17	51.21	50.68	50.95
V_2 – Virat	61.11	60.39	60.75	36.97	36.84	36.90
V_3 - Phule G 16318	65.97	64.31	65.14	40.58	40.50	40.54
SE ±	0.28	0.25	0.19	0.13	0.13	0.09
CD at 5%	0.79	0.70	0.54	0.37	0.35	0.26
Treatments (T)						
T_1 - Control	54.44	52.33	53.39	39.76	39.17	39.46
T_2 - Sodium Nitroprusside (SNP) @ 25 ppm	62.00	60.00	61.00	44.48	43.10	43.79
T_3 - Sodium Nitroprusside (SNP) @ 25 ppm + Vitavax 0.25%	63.89	62.67	63.28	46.51	45.94	46.22
T_4 - Potassium nitrite (KNO_2) @ 50 ppm	58.56	57.89	58.22	41.47	42.45	41.96
T_5 - Potassium nitrite (KNO_2) @ 50 ppm + Vitavax 0.25%	61.00	59.33	60.17	43.29	42.69	42.99
T_6 - Potassium nitrate (KNO_3) @ 100 ppm	60.56	57.44	59.00	42.25	42.25	42.25
T_7 - Potassium nitrate (KNO_3) @ 100 ppm + Vitavax0.25%	62.56	60.89	61.72	44.62	44.17	44.40
T_8 - Calcium chloride ($CaCl_2$) @ 2%	56.93	56.33	56.63	42.20	42.09	42.15
T_9 - Calcium chloride ($CaCl_2$) @ 2% + Vitavax 0.25%	58.95	57.44	58.20	43.13	43.44	43.28
T_{10} - Salicylic acid @ 10 ppm	57.78	56.67	57.22	42.61	42.08	42.35
T_{11} - Salicylic acid @ 10 ppm + Vitavax 0.25%	59.56	58.33	58.94	42.98	42.88	42.93
T_{12} - Vitavax @ 0.25%	57.22	55.67	56.44	41.76	41.82	41.79
SE (±)	0.56	0.50	0.38	0.26	0.25	0.19
CD at 5%	1.57	1.40	1.07	0.73	0.71	0.52

Table 2 (a). Effect of interactions (V × T) on number of pods per plant and seed index (g) of kabuli chickpea.

(V×T)	**Number of pods per plant**			**Seed index (g)**		
	2021-22	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**
V_1T_1	45.00	43.67	**44.33**	47.00	46.00	**46.50**
V_1T_2	53.67	51.33	**52.50**	53.40	51.00	**52.20**
V_1T_3	56.33	53.33	**54.83**	56.67	54.47	**55.57**
V_1T_4	48.33	50.33	**49.33**	49.33	49.62	**49.48**
V_1T_5	53.33	49.33	**51.33**	51.33	50.15	**50.74**
V_1T_6	52.67	50.00	**51.33**	50.00	50.59	**50.30**
V_1T_7	54.33	52.33	**53.33**	53.80	52.33	**53.07**
V_1T_8	50.45	45.33	**47.89**	49.67	50.78	**50.22**
V_1T_9	53.19	46.33	**49.76**	52.00	52.00	**52.00**
V_1T_{10}	49.33	49.00	**49.17**	51.00	49.91	**50.46**
V_1T_{11}	52.00	50.67	**51.33**	50.67	51.41	**51.04**
V_1T_{12}	46.67	47.00	**46.83**	49.67	49.89	**49.78**
V_2T_1	57.67	55.33	**56.50**	34.27	34.00	**34.13**
V_2T_2	63.67	62.67	**63.17**	38.47	37.33	**37.90**
V_2T_3	65.67	66.00	**65.83**	39.96	39.09	**39.53**
V_2T_4	61.67	59.33	**60.50**	35.30	37.40	**36.35**
V_2T_5	63.00	61.00	**62.00**	37.67	37.33	**37.50**
V_2T_6	63.00	59.00	**61.00**	36.67	36.03	**36.35**
V_2T_7	64.67	63.33	**64.00**	37.67	38.43	**38.05**
V_2T_8	57.00	59.33	**58.17**	36.59	35.57	**36.08**
V_2T_9	58.00	62.00	**60.00**	37.10	37.77	**37.43**
V_2T_{10}	60.00	59.67	**59.83**	37.00	36.33	**36.67**
V_2T_{11}	60.67	60.67	**60.67**	37.27	36.77	**37.02**
V_2T_{12}	58.33	56.33	**57.33**	35.67	36.00	**35.83**
V_3T_1	60.67	58.00	**59.33**	38.00	37.52	**37.76**
V_3T_2	68.67	66.00	**67.33**	41.57	40.96	**41.26**
V_3T_3	69.67	68.67	**69.17**	42.90	44.26	**43.58**
V_3T_4	65.67	64.00	**64.83**	39.77	40.33	**40.05**

V_3T_5	66.67	67.67	**67.17**	40.86	40.59	**40.73**
V_3T_6	66.00	63.33	**64.67**	40.09	40.12	**40.11**
V_3T_7	68.67	67.00	**67.83**	42.39	41.74	**42.07**
V_3T_8	63.33	64.33	**63.83**	40.33	39.93	**40.13**
V_3T_9	65.67	64.00	**64.83**	40.29	40.54	**40.42**
V_3T_{10}	64.00	61.33	**62.67**	39.84	39.98	**39.91**
V_3T_{11}	66.00	63.67	**64.83**	41.00	40.48	**40.74**
V_3T_{12}	66.67	63.67	**65.17**	39.94	39.56	**39.75**
SE (±)	**0.97**	**0.86**	**0.67**	**0.45**	**0.43**	**0.32**
CD at 5%	**2.72**	**2.42**	**1.86**	**1.27**	**1.22**	**0.90**

Table 3 : Effect of varieties (V) and priming treatments (T) and their interactions (V × T) on seed yield per plant (g) of kabuli chickpea.

	Seed yield/plant (g)		
	2021-22	**2022-23**	**Pooled**
Varieties (V)			
V_1 – Kripa	25.09	24.22	**24.65**
V_2 – Virat	23.94	22.41	**23.18**
V_3 - Phule G-16318	26.43	26.02	**26.23**
SE ±	**0.16**	**0.28**	**0.16**
CD at 5%	**0.45**	**0.78**	**0.46**
Treatments (T)			
T_1 – Control	22.11	21.67	**21.89**
T_2 - Sodium Nitroprusside (SNP) @ 25 ppm	25.93	25.55	**25.74**
T_3 - Sodium Nitroprusside (SNP) @ 25 ppm + Vitavax 0.25%	28.20	27.51	**27.85**
T_4 - Potassium nitrite (KNO_2) @ 50 ppm	24.38	23.81	**24.09**
T_5 - Potassium nitrite (KNO_2) @ 50 ppm + Vitavax 0.25%	24.95	24.31	**24.63**
T_6 - Potassium nitrate (KNO_3) @ 100 ppm	25.36	25.19	**25.27**
T_7 - Potassium nitrate (KNO_3) @ 100 ppm + Vitavax0.25%	26.80	26.24	**26.52**
T_8 - Calcium chloride ($CaCl_2$) @ 2%	24.63	23.08	**23.85**
T_9 - Calcium chloride ($CaCl_2$) @ 2% + Vitavax 0.25%	25.02	24.16	**24.59**
T_{10} - Salicylic acid @ 10 ppm	24.75	22.85	**23.80**
T_{11} - Salicylic acid @ 10 ppm + Vitavax 0.25%	25.48	24.09	**24.79**
T_{12} - Vitavax @ 0.25%	24.23	22.15	**23.19**
SE (±)	**0.32**	**0.55**	**0.33**
CD at 5%	**0.90**	**1.56**	**0.92**

Table 3 (a) : Effect of interactions (V × T) on seed yield per plant (g) of kabuli chickpea

Variety × Treatment (V×T)							
V × T	**2021-22**	**2022-23**	**Pooled**	**V × T**	**2021-22**	**2022-23**	**Pooled**
V_1T_1	21.20	21.33	**21.27**	**V_2T_8**	23.05	20.58	**21.81**
V_1T_2	25.93	24.60	**25.27**	**V_2T_9**	25.63	21.53	**23.58**
V_1T_3	28.33	26.00	**27.17**	**V_2T_{10}**	23.63	18.51	**21.07**
V_1T_4	25.30	23.67	**24.48**	**V_2T_{11}**	24.60	21.12	**22.86**
V_1T_5	25.57	24.33	**24.95**	**V_2T_{12}**	22.33	18.11	**20.22**
V_1T_6	25.23	24.53	**24.88**	**V_3T_1**	24.40	23.67	**24.03**
V_1T_7	26.37	26.00	**26.18**	**V_3T_2**	26.37	26.47	**26.42**
V_1T_8	24.73	23.33	**24.03**	**V_3T_3**	29.40	28.67	**29.03**
V_1T_9	24.20	24.47	**24.33**	**V_3T_4**	26.10	25.33	**25.72**
V_1T_{10}	24.47	24.37	**24.42**	**V_3T_5**	26.17	26.33	**26.25**
V_1T_{11}	25.23	24.97	**25.10**	**V_3T_6**	26.27	26.13	**26.20**
V_1T_{12}	24.50	23.00	**23.75**	**V_3T_7**	28.47	26.67	**27.57**
V_2T_1	20.73	20.01	**20.37**	**V_3T_8**	26.10	25.33	**25.72**
V_2T_2	25.49	25.59	**25.54**	**V_3T_9**	25.23	26.47	**25.85**
V_2T_3	26.86	27.87	**27.36**	**V_3T_{10}**	26.17	25.67	**25.92**
V_2T_4	21.73	22.43	**22.08**	**V_3T_{11}**	26.60	26.20	**26.40**
V_2T_5	23.13	22.27	**22.70**	**V_3T_{12}**	25.87	25.33	**25.60**
V_2T_6	24.58	24.90	**24.74**	**SEm (±)**	**0.56**	**0.96**	**0.57**
V_2T_7	25.57	26.06	**25.82**	**CD @ 5%**	**1.57**	**2.71**	**1.60**

Authors contribution

MRM, MTB, VRS and NSK conceptualized the theme; MRM and MTB wrote the manuscript; MRP analyzed the data; MRM, MTB, VRS, NSK, SRZ and MRP worked on final check of manuscript.

Conflict of interest: None

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