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Kalaria RV
Ph.D. Scholar, Department of
Agronomy, JAU, Junagadh,
Gujarat, India

Daki RN
Assistant Research Scientist, Main
Oilseeds Research Station, JAU,
Junagadh, Gujarat, India

Gajera JB
Research Associate, AgroMet Cell,
Department of Agronomy, JAU,
Junagadh, Gujarat, India

Kachhadiya SP
Associate Research Scientist, Main
Oilseeds Research Station, JAU,
Junagadh, Gujarat, India

Hirapara KV
Assistant Professor, Department of
Agronomy, JAU, Junagadh,
Gujarat, India

Corresponding Author:

Kalaria RV
Ph.D. Scholar, Department of
Agronomy, JAU, Junagadh,
Gujarat, India

Effect of irrigation, mulch and antitranspirants on growth, yield and quality of summer soybean [*Glycine max* (L.) Merrill]

Kalaria RV, Daki RN, Gajera JB, Kachhadiya SP and Hirapara KV

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Abstract

A field experiment was conducted during summer seasons of 2024 and 2025 at Junagadh Agricultural University, Junagadh, to study the effect of irrigation, mulching and antitranspirants on growth, yield and quality of summer soybean under South Saurashtra agro-climatic conditions. Experiment comprising eighteen treatment combinations was laid out in Split Split Plot Design (SSPD) with three replications. The treatments consisted of three irrigation levels viz., surface irrigation at 1.0 IW: CPE ratio (I₁), drip irrigation at 0.6 PEF (I₂) and drip irrigation at 0.8 PEF (I₃); mulch treatments viz., no mulch (M₀) and residue mulch at 5 t/ha (M₁); and antitranspirant treatments viz., water spray (AT₀), potassium nitrate 1% spray (AT₁) and glycerol 5% spray (AT₂) at 30 and 45 DAS. Results revealed that plant height, number of branches per plant, dry matter production, number of pods per plant, seed yield and stover yield at harvest were significantly improved under drip irrigation at 0.8 PEF, residue mulch 5 t/ha and KNO₃ spray at 1% in 2024, 2025 and in pooled results. Days to 50% flowering remained unaffected by treatments. The interaction effect among irrigation, mulch and antitranspirants was significant for dry matter production, number of pods per plant, seed yield and stover yield, wherein treatment combination I₃M₁AT₁ recorded the highest values. Protein and oil content were not significantly influenced by treatments, although comparatively higher values were observed under drip irrigation at 0.8 PEF, residue mulch and KNO₃ spray. The study concluded that drip irrigation at 0.8 PEF combined with residual mulch at 5 t/ha and foliar treatment of potassium nitrate 1% at 30 and 45 DAS showed efficient for boosting growth, yield attributes and productivity of summer soybean under South Saurashtra agro-climatic conditions.

Keywords: irrigation, mulch, antitranspirants, soybean

Introduction

Soybean [*Glycine max* (L.) Merrill] is one of the major important oilseed crops in the world and belongs to the family Fabaceae, sub-family Faboideae. Soybean is a valuable agricultural commodity with enormous global relevance because of its contribution to food security, nutrition and industrial applications worldwide. Its nutritional value, including important proteins and oils, has made it a staple of the human diet. Furthermore, its adaptability to various climates and involvement in sustainable agriculture emphasize its importance (Mishra *et al.*, 2024) [16]. In India, oil consumption has steadily increased due to population growth and rising living standards (Chung and Sing, 2008) [3].

Soybean accounts for approximately 50% of oilseed production and 30% of global vegetable oil supply. Soybean is considered a wonder crop due to its dual qualities viz., high protein (40-42%) and oil content (20%). Soybean accounts for approximately 50% of oilseed production and 30% of global vegetable oil supply. Soybean is regarded as a wonder crop because to its high protein (40-42%) and oil content (20%). Soybean protein contains lysine (approximately 5.5%), which is deficient in most cereals. Approximately 85% of soybeans produced are used for oil extraction, 10% for seed and 5% for consumption. Soybean, as a potentially high-yielding crop, has the potential to significantly increase oilseed production in India.

As a subtropical country, India is experiencing changes in weather patterns and rising temperatures, which have an impact on agricultural production. Water is essential for plant growth and development (Rijsberman, 2006) [19]. Rainfall and irrigation are the two primary

sources of water in agriculture. Because most soybean-growing regions in India have dry climates, the crop faces heat, moisture and nutrient stress throughout critical growth phases (Tamagno *et al.*, 2017) ^[25].

Soybean is highly sensitive to soil moisture stress and water deficiency at any stage of growth can adversely affect plant development, yield and yield attributes (Mahmoud *et al.*, 2013) ^[13]. Among various irrigation methods, drip irrigation enables a more effective water supply to plants because of ease in controlling watering (Dasberg and Or, 1999) ^[4]. Drip technique enhances irrigation efficiency by minimizing evaporation from the soil surface, eliminating runoff and deep percolation and allowing for uniform water application in fields (Skaggs, 2001) ^[24]. These irrigation management strategies save a lot of water while offering equivalent economic rewards (Montoya *et al.*, 2017) ^[17].

Mulches enhance soil quality, regulate soil temperature, inhibit weed growth and prevent moisture loss (Billore, 2017) ^[1]. Straw mulch helps to regulate soil temperature by lowering maximum temperature (Sarbjee and Kler, 1990) ^[21] and increasing minimum temperature in the seed zone (Kitou and Yoshida, 1994) ^[12], as well as retaining soil moisture (Munn, 1992) ^[18]. Proper moisture control during the flowering period is crucial to soybean output. Certain compounds can successfully prevent water loss and increase yield under moisture stress circumstances. Antitranspirants disrupt guard cells at stomatal pores, reducing water vapour loss while not influencing CO₂ intake (Sivadjian, 1967) ^[23]. The most effective antitranspirants diminish transpiration while having no phytotoxic effects on plants (Jamir *et al.*, 2015) ^[8].

Materials and Methods

The climate of Junagadh is characterized as tropical wet and dry with three well-defined seasons. The winter season is mild starting in November and extending up to February with December and January being the coldest months. The summer season spans from the latter half of February to mid-June followed by the monsoon season from July to October. Summers are generally intense, with temperatures ranging between 28 °C and 38 °C and April and May being the hottest months. During winter temperatures usually range from 10 °C to 25 °C. The experiment comprising of eighteen treatment combinations and it was laid out in Split Split Plot Design (SSPD) with three replications for field trial were used to carry out the present investigation. The main plot treatments included three irrigation levels, namely surface irrigation at 1.0 IW:CPE ratio (I₁), drip irrigation at 0.6 PEF (I₂) and drip irrigation at 0.8 PEF (I₃). The sub plot treatments consisted of mulching levels viz., no mulch (M₀) and residue mulch @ 5 t/ha (M₁). The sub-sub plot treatments comprised antitranspirant applications, namely control with water spray at 30 and 45 DAS (AT₀), potassium nitrate 1% spray at 30 and 45 DAS (AT₁) and glycerol 5% at 30 and 45 DAS (AT₂). The present investigation was carried out using soybean variety “G. Soy 4” (Gujarat Soybean 4: Sorath Sonali). The variety was developed at the Agricultural Research Station, JAU, Amreli through hybridization followed by pedigree method of selection involving cross between JS 335 × GJS 3 and released in the year 2022. The variety is popular among farmers due to its high yield potential and better pod-bearing capacity, with an average seed yield of about 2160 kg/ha.

Results and Discussion

Growth Parameters

Plant height at harvest differed significantly due to irrigation,

mulching and antitranspirant treatments. Drip irrigation at 0.8 PEF (I₃) resulted in taller plants compared to 0.6 PEF (I₂). This could be attributed to increased soil moisture availability during crop growth, leading to improved nutrient absorption and vegetative development.

These findings are in close conformity with those reported by Mathukia *et al.* (2019) ^[14] and Singh and Singh (2021) ^[22]. Residue mulch at 5 t/ha (M₁) also recorded higher plant height over no mulch, probably because mulch reduced moisture loss and maintained favourable soil hydrothermal conditions. Similar results were reported by Dass and Bhattacharyya (2017) ^[5]. Among antitranspirants, KNO₃ spray at 30 and 45 DAS (AT₁) recorded higher plant height than water spray, which could be due to improved stomatal regulation and maintenance of plant water relations under moisture stress conditions. Similar observations were noted by Sanbagavalli *et al.* (2017) ^[20].

Number of branches per plant was markedly influenced by irrigation, mulching and antitranspirant treatments. Higher branching under drip irrigation at 0.8 PEF could be attributed to favorable moisture conditions that fostered continuous meristematic activity and improved assimilate partitioning toward vegetative growth. Khadse *et al.* (2017) ^[11] observed similar findings. Residue mulch at 5 t/ha (M₁) increased branch formation, presumably due to greater root activity and nutrient availability under conserved soil moisture conditions. Kamble *et al.* (2017) ^[9] and Jain *et al.* (2018) ^[7] have also reported comparable results. KNO₃ spray resulted in higher number of branches per plant, which may be attributed to its role in maintaining cellular turgidity and metabolic activity during stress period. Similar trends were observed by Dass and Bhattacharyya (2017) ^[5].

Days to 50 per cent flowering remained unaffected by irrigation, mulching and antitranspirant treatments during both years as well as in pooled analysis. The non-significant effect could be attributed to the fact that flowering behavior in soybean is predominantly governed by genetic constitution and photoperiod sensitivity rather than external agronomic management approaches.

Dry matter production at harvest was significantly enhanced by irrigation, mulching and antitranspirant treatments. Higher dry matter accumulation under drip irrigation at 0.8 PEF was mainly due to better availability of moisture in the root zone, which favoured efficient photosynthesis and continuous biomass production. Similar findings were reported by Chomsang *et al.* (2021) ^[2] and Gajera *et al.* (2024) ^[6]. Residue mulch at 5 t/ha (M₁) increased dry matter production by reducing evaporation and creating favorable soil conditions for crop development and assimilation. Dass and Bhattacharyya (2017) ^[5] and Sanbagavalli *et al.* (2017) ^[20] also found similar results. KNO₃ spray outperformed other antitranspirants in terms of dry matter production, possibly due to lower transpiration losses and increased physiological efficiency under stress. Similar observations were also reported by Jain *et al.* (2018) ^[7]. The interaction effect of irrigation, mulch and antitranspirants was significant in pooled analysis, wherein treatment combination I₃M₁AT₁ recorded the highest dry matter production due to the combined beneficial effect of optimum moisture supply, moisture conservation and stress reduction.

Yield Attributes and Yields

Drip irrigation at 0.8 PEF (I₃) consistently recorded superior yield attributes and yields over drip irrigation at 0.6 PEF (I₂). Adequate and continuous moisture availability under optimum irrigation might have enhanced nutrient uptake, photosynthetic

efficiency and assimilate translocation, resulting in increased pods per plant, seed yield and stover yield. Proper moisture availability during reproductive stages also reduced flower and pod shedding and improved pod development. Similar findings were reported by Mathukia *et al.* (2019) ^[14], Khadse *et al.* (2017) ^[11], Kaur *et al.* (2020) ^[10] and Gajera *et al.* (2024) ^[6].

Residue mulch at 5 t/ha (M₁) significantly improved yield parameters over no mulch treatment. The beneficial effect of mulch might be due to reduced evaporation losses, better soil moisture conservation and moderation of soil temperature, which created favourable conditions for root growth, nutrient uptake and photosynthetic activity. Improved soil moisture regime under mulched conditions promoted vegetative growth and reproductive development, resulting in more pods per plant, seed output and stover yield. Similar trends have been documented by Billore (2017) ^[1], Maurya *et al.* (2019) ^[15], Dass and Bhattacharyya (2017) ^[5] and Jamir *et al.* (2015) ^[8].

Among antitranspirants, KNO₃ spray at 30 and 45 DAS (AT₁) recorded superior performance with respect to growth and yield parameters compared to water spray (AT₀). The increase under KNO₃ application might be attributed to improved plant water status through reduced transpiration losses and better stomatal regulation under moisture stress conditions. In addition, potassium and nitrogen supplied through KNO₃ enhanced photosynthetic activity, metabolic processes and assimilate translocation, which ultimately improved growth and yield components. Similar findings were reported by Dass and Bhattacharyya (2017) ^[5], Sanbagavalli *et al.* (2017) ^[20] and Jain *et al.* (2018) ^[7].

The interaction effect among irrigation, mulch and antitranspirants was significant for number of pods per plant, seed yield and stover yield. Treatment combination I₃M₁AT₁ recorded the highest values for these parameters, indicating the combined beneficial effect of optimum moisture supply through drip irrigation, moisture conservation by residue mulch and stress alleviation through KNO₃ spray. This integrated approach created favourable soil and plant conditions, resulting in improved physiological efficiency, biomass accumulation and productivity of summer soybean.

Quality Parameters

Protein and oil content of summer soybean were not significantly influenced by irrigation levels, mulching and antitranspirant treatments during both the years and pooled analysis. Drip irrigation at 0.8 PEF (I₃) resulted in significantly greater protein and oil content in 2024, 2025 and pooled analysis. The non-significant response could be attributed to the fact that protein and oil content are mostly determined by the variety's genetic composition and metabolic properties, rather than agronomic management measures alone. Residue mulch at 5 t/ha (M₁) had higher protein and oil content than no mulch treatment (M₀), but the differences were not statistically significant. KNO₃ spray at 30 and 45 DAS (AT₁) had increased protein and oil content in 2024, 2025 and pooled analysis compared to water spray (AT₀). The minor improvement under KNO₃ spray could be due to improved nutrition availability and physiological activity under moisture stress circumstances. However, the variations were not statistically significant.

Table 1: Effect of irrigation, mulch and antitranspirants on plant height, number of branches/plant, days to 50% flowering and dry matter production

Treatment		Plant height (cm)			Number of branches/plant			Days to 50% flowering			Dry matter production (g/plant)		
		2024	2025	Pooled	2024	2025	Pooled	2024	2025	Pooled	2024	2025	Pooled
I1: SI at 1.0 IW/CPE		34.36	35.19	34.78	4.51	4.60	4.56	40.19	40.70	40.44	17.87	18.49	18.18
I2: DI at 0.6 PEF		32.13	32.97	32.55	3.97	4.08	4.03	39.16	39.71	39.44	15.58	16.23	15.91
I3: DI at 0.8 PEF		37.84	38.82	38.33	4.97	5.02	4.99	41.52	41.76	41.64	19.88	20.69	20.29
SEM		0.69	0.72	0.50	0.11	0.11	0.08	0.81	0.80	0.57	0.43	0.45	0.31
CD 5%		2.70	2.84	1.63	0.42	0.43	0.25	NS	NS	NS	1.67	1.77	1.01
CV%		8.40	8.60	8.51	10.07	10.10	10.09	8.48	8.38	8.43	10.17	10.35	10.27
M0: Control		33.28	34.17	33.72	4.29	4.38	4.33	39.96	40.42	40.19	16.83	17.47	17.15
M1: RM at 5 t/ha		36.27	37.16	36.72	4.69	4.75	4.72	40.62	41.03	40.83	18.73	19.47	19.10
SEM		0.82	0.86	0.34	0.13	0.11	0.05	1.08	1.08	0.44	0.48	0.48	0.20
CD 5%		2.85	2.98	1.06	0.46	0.39	0.16	NS	NS	NS	1.66	1.68	0.61
CV%		7.11	7.23	7.17	8.88	7.49	8.20	8.01	7.96	7.99	8.11	7.87	7.99
AT0: WS spray at 30 & 45 DAS		33.00	33.80	33.40	4.13	4.26	4.19	39.53	40.07	39.80	16.23	16.87	16.55
AT1: KNO3 spray at 30 & 45 DAS		36.43	37.43	36.93	4.73	4.75	4.74	41.13	41.60	41.37	19.01	19.75	19.38
AT2: Glycerol spray at 30 & 45 DAS		34.90	35.75	35.33	4.60	4.69	4.64	40.21	40.49	40.35	18.09	18.79	18.44
SEM		0.52	0.55	0.38	0.09	0.08	0.06	0.63	0.64	0.45	0.30	0.29	0.21
CD 5%		1.51	1.59	1.07	0.27	0.23	0.17	NS	NS	NS	0.86	0.86	0.59
CV%		6.30	6.49	6.40	8.70	7.40	8.06	6.68	6.71	6.69	7.05	6.74	6.89
I × M	SEM	0.82	0.86	0.60	0.13	0.11	0.09	1.08	1.08	0.76	0.48	0.48	0.34
	CD 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
I × AT	SEM	0.89	0.94	0.65	0.16	0.14	0.11	1.10	1.12	0.78	0.51	0.51	0.36
	CD 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
M × AT	SEM	0.73	0.77	0.53	0.13	0.11	0.09	0.90	0.91	0.64	0.42	0.42	0.29
	CD 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
I × M × AT	SEM	1.27	1.34	0.92	0.23	0.19	0.15	1.55	1.58	1.11	0.72	0.72	0.51
	CD 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.10	1.45
Y	SEM	0.41			0.06			0.46			0.25		
	CD 5%	NS			NS			NS			NS		

Table 2: Effect of irrigation, mulch and antitranspirants on number of pods/plant, seed yield and stover yield

Treatment		Number of pods/plant			Seed Yield (kg/ha)			Stover Yield (kg/ha)		
		2024	2025	Pooled	2024	2025	Pooled	2024	2025	Pooled
I1: SI at 1.0 IW/CPE		34.03	35.45	34.74	1433	1513	1473	2053	2101	2077
I2: DI at 0.6 PEF		29.66	30.83	30.24	1271	1341	1306	1790	1833	1811
I3: DI at 0.8 PEF		37.74	39.37	38.56	1660	1752	1706	2283	2343	2313
SEM		0.86	0.95	0.64	43.38	46.26	31.71	55.31	54.48	38.82
CD 5%		3.37	3.72	2.08	170	182	103	217.17	213.92	126.59
CV%		10.76	11.42	11.11	12.65	12.78	12.73	11.49	11.05	11.27
M0: Control		32.10	33.40	32.75	1367	1442	1404	1929	1975	1952
M1: RM at 5 t/ha		35.52	37.04	36.28	1543	1629	1586	2155	2210	2183
SEM		0.91	0.96	0.38	38.57	41.10	16.27	60.91	56.47	23.98
CD 5%		3.14	3.32	1.17	133	142	50	210.76	195.43	73.88
CV%		8.06	8.16	8.12	7.95	8.03	8.00	8.95	8.10	8.52
AT ₀ : WS spray at 30 & 45 DAS		31.01	32.30	31.66	1328	1401	1365	1865	1909	1887
AT ₁ : KNO ₃ spray at 30 & 45 DAS		36.15	37.66	36.91	1546	1632	1589	2182	2235	2208
AT ₂ : Glycerol spray at 30 & 45 DAS		34.26	35.69	34.98	1491	1573	1532	2078	2133	2106
SEM		0.54	0.56	0.39	21.04	22.50	15.40	36.02	35.10	25.15
CD 5%		1.57	1.64	1.10	61	66	44	105.14	102.45	71.51
CV%		6.75	6.76	6.76	6.14	6.22	6.18	7.49	7.12	7.30
I × M	SEM	0.91	0.96	0.66	38.57	41.10	28.18	60.91	56.47	41.53
	CD 5%	NS	NS	NS	NS	NS	506.40	NS	NS	NS
I × AT	SEM	0.93	0.97	0.67	36.44	38.96	26.68	62.39	60.80	43.56
	CD 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
M × AT	SEM	0.76	0.79	0.55	29.76	31.81	21.78	50.94	49.64	35.56
	CD 5%	NS	NS	NS	NS	NS	61.93	NS	NS	NS
I × M × AT	SEM	1.32	1.37	0.95	51.54	55.10	37.72	88.24	85.98	61.60
	CD 5%	3.84	4.01	2.71	150.44	160.83	107.27	257.55	250.95	175.16
Y	SEM	0.52			25.89			31.69		
	CD 5%	NS			NS			NS		

Table 3: Effect of irrigation, mulch and antitranspirants on protein content and oil content

Treatment		Protein Content (%)			Oil Content (%)		
		2024	2025	Pooled	2024	2025	Pooled
I1: SI at 1.0 IW/CPE		36.35	36.72	36.53	19.03	19.08	19.06
I2: DI at 0.6 PEF		35.46	35.69	35.58	18.57	18.62	18.59
I3: DI at 0.8 PEF		37.59	37.98	37.78	19.52	19.69	19.60
SEM		0.89	0.83	0.61	0.36	0.37	0.26
CD 5%		NS	NS	NS	NS	NS	NS
CV%		10.34	9.59	9.97	8.06	8.29	8.18
M0: Control		36.08	36.42	36.25	18.86	18.92	18.89
M1: RM at 5 t/ha		36.848	37.169	37.009	19.21	19.34	19.28
SEM		1.10	1.00	0.43	0.51	0.49	0.20
CD 5%		NS	NS	NS	NS	NS	NS
CV%		9.08	8.16	8.63	7.98	7.75	7.87
AT ₀ : WS spray at 30 & 45 DAS		35.77	36.09	35.93	18.74	18.79	18.76
AT ₁ : KNO ₃ spray at 30 & 45 DAS		37.12	37.46	37.29	19.34	19.51	19.43
AT ₂ : Glycerol spray at 30 & 45 DAS		36.50	36.83	36.67	19.03	19.09	19.06
SEM		0.55	0.63	0.42	0.27	0.29	0.20
CD 5%		NS	NS	NS	NS	NS	NS
CV%		6.36	7.28	6.84	6.09	6.38	6.24
I × M	SEM	1.10	1.00	0.75	0.51	0.49	0.35
	CD 5%	NS	NS	NS	NS	NS	NS
I × AT	SEM	0.95	1.09	0.72	0.47	0.50	0.34
	CD 5%	NS	NS	NS	NS	NS	NS
M × AT	SEM	0.77	0.89	0.59	0.39	0.41	0.28
	CD 5%	NS	NS	NS	NS	NS	NS
I × M × AT	SEM	1.34	1.55	1.02	0.67	0.70	0.49
	CD 5%	NS	NS	NS	NS	NS	NS
Y	SEM	0.50			0.21		
	CD 5%	NS			NS		

Table 4: Interaction effect of I × M × AT on dry matter production at harvest of summer soybean

Treatment	Dry matter production (g/plant)								
	2024			2025			Pooled		
	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃
M ₀ AT ₀	15.59	11.19	18.67	16.17	11.82	19.36	15.88	11.50	19.02
M ₀ AT ₁	18.32	16.85	19.44	19.00	17.69	20.16	18.66	17.27	19.80
M ₀ AT ₂	18.04	14.34	19.02	18.49	14.86	19.72	18.26	14.60	19.37
M ₁ AT ₀	17.34	15.73	18.88	17.98	16.31	19.58	17.66	16.02	19.23
M ₁ AT ₁	19.09	17.83	22.52	19.79	18.49	23.35	19.44	18.16	22.93
M ₁ AT ₂	18.81	17.55	20.77	19.50	18.20	21.98	19.16	17.88	21.37
SEM	0.72			0.72			0.51		
CD 5%	NS			2.10			1.45		

Table 5: Interaction effect of I × M × AT on number of pods/plant of summer soybean

Treatment	Number of pods/plant								
	2024			2025			Pooled		
	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃
M ₀ AT ₀	29.72	21.72	35.59	30.96	22.63	37.07	30.34	22.18	36.33
M ₀ AT ₁	34.92	32.12	37.05	36.38	33.11	38.60	35.65	32.62	37.83
M ₀ AT ₂	34.39	26.99	36.39	35.82	28.12	37.90	35.10	27.55	37.14
M ₁ AT ₀	33.05	29.99	35.99	34.43	31.24	37.49	33.74	30.61	36.74
M ₁ AT ₁	36.25	33.65	42.92	37.76	35.06	45.05	37.01	34.36	43.99
M ₁ AT ₂	35.85	33.45	38.52	37.35	34.85	40.13	36.60	34.15	39.32
SEM	1.32			1.37			0.95		
CD 5%	3.84			4.01			2.71		

Table 6: Interaction effect of I × M × AT on seed yield of summer soybean

Treatment	Seed yield (kg/ha)								
	2024			2025			Pooled		
	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃
M ₀ AT ₀	1252	1048	1499	1321	1100	1582	1287	1074	1540
M ₀ AT ₁	1471	1353	1561	1552	1428	1647	1512	1390	1604
M ₀ AT ₂	1448	1137	1532	1529	1200	1618	1488	1168	1575
M ₁ AT ₀	1392	1263	1516	1469	1333	1600	1431	1298	1558
M ₁ AT ₁	1527	1417	1946	1612	1496	2054	1569	1457	2000
M ₁ AT ₂	1510	1409	1908	1594	1487	2013	1552	1448	1960
SEM	51.54			55.10			37.72		
CD 5%	150.44			160.83			107.27		

Table 7: Interaction effect of I × M × AT on stover yield of summer soybean

Treatment	Stover yield (kg/ha)								
	2024			2025			Pooled		
	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃
M ₀ AT ₀	1792	1285	2145	1834	1316	2196	1813	1300	2171
M ₀ AT ₁	2105	1936	2190	2155	1982	2246	2130	1959	2218
M ₀ AT ₂	2073	1647	2185	2122	1686	2237	2097	1666	2211
M ₁ AT ₀	1992	1808	2169	2040	1851	2221	2016	1829	2195
M ₁ AT ₁	2193	2049	2620	2245	2097	2682	2219	2073	2651
M ₁ AT ₂	2161	2016	2386	2212	2064	2477	2187	2040	2432
SEM	88.24			85.98			61.60		
CD 5%	257.55			250.95			175.16		

Conclusion

The present investigation found that irrigation, mulching and antitranspirant treatments all had a significant impact on summer soybean growth parameters, yield attributes and yield. Drip irrigation at 0.8 PEF, residue mulch at 5 t/ha and 1% potassium nitrate foliar application at 30 and 45 DAS significantly improved plant height, number of branches per plant, dry matter accumulation and number of pods per plant, resulting in increased soybean seed and stover yield. Therefore, adopting

drip irrigation at 0.8 PEF in combination with residue mulch 5 t/ha and foliar application of potassium nitrate 1% at 30 and 45 DAS can be considered an effective management practice for improving growth and productivity of summer soybean under South Saurashtra agro-climatic conditions.

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