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Effect of clipping, plant growth regulators and weed management on growth of summer sesame (*Sesamum indicum* L.)

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Abstract

A field experiment entitled “Effect of clipping, plant growth regulators and weed management on summer sesame (*Sesamum indicum* L.)” was conducted during the summer seasons of 2022 and 2023 at the Instructional Farm, Department of Agronomy, Junagadh Agricultural University, Junagadh. The study aimed to evaluate the impact of clipping, plant growth regulators and weed management practices on the growth, yield, quality and economics of summer sesame under medium black calcareous soil. The experimental results revealed that significantly higher values of growth parameters viz., plant height, dry matter accumulation and the number of branches per plant were recorded with clipping at 45 DAS, foliar application of GA₃ @ 200 ppm at 50 DAS and The sequential application of pendimethalin 0.50 kg/ha PE followed by quizalofop-p-ethyl 0.05 kg/ha PoE.

Keywords: Clipping, plant growth regulators, weed management and growth

Introduction

Sesame (*Sesamum indicum* L.) is one of the oldest oilseed crops cultivated by humankind and holds a significant place among oilseeds next to groundnut, rapeseed, and mustard in India. Belonging to the family Pedaliaceae, it is predominantly grown in tropical and subtropical regions, though it has successfully spread to temperate zones as well. Africa is regarded as the primary center of origin, from where sesame spread to West Asia, India, China, and Japan-emerging as secondary centers of diversity (Zebib *et al.*, 2015) ^[1]. In India, sesame is known by various names such as til, gingelly, simsim, and gergelim, and is often referred to as the "poor man's ghee" due to its valuable oil content and economic accessibility.

In recent years, sesame has gained recognition as a "survival crop" because of its resilience to adverse climatic conditions. It is primarily a self-pollinated crop with a natural outcrossing rate of 4-5%. Sesame is highly adaptable and drought tolerant, making it suitable for low-input farming systems. Despite its high-quality oil content (34-63%), protein (25%), and other nutraceutical properties, sesame's productivity remains low in India due to several constraints such as poor agronomic practices, biotic and abiotic stresses, and the predominant cultivation under rainfed conditions using traditional varieties.

India ranks among the top global producers of sesame, with significant cultivation spread across the states of Uttar Pradesh, Rajasthan, Gujarat, Andhra Pradesh, Tamil Nadu, and others. Gujarat alone contributed approximately 1.85 lakh ha area and 0.92 lakh tonnes of production in 2022-23 (Anon., 2024) ^[2]. Notably, the summer season sesame area in Gujarat is increasing owing to favourable climatic conditions, assured irrigation and lower incidence of pests and diseases.

Despite the crop's potential, several challenges such as weed competition, improper water and nutrient management, limited access to improved varieties, and suboptimal plant population significantly reduce yields. Physiologically, poor source-sink dynamics, low translocation efficiency, and excessive vegetative growth under high moisture conditions also contribute to low productivity.

To bridge the yield gap, recent studies have focused on innovative agronomic interventions. Among them, terminal clipping, plant growth regulator (PGR) application, and effective weed

management have shown promising results. Clipping, which involves removal of the apical meristem, promotes lateral branching and enhances light penetration and photosynthetic efficiency. PGRs such as gibberellic acid (GA₃) and indole-3-acetic acid (IAA) play vital roles in enhancing growth parameters, reproductive development, and yield when applied at appropriate stages and concentrations. Additionally, judicious herbicide use provides effective weed control, particularly during the critical competition period (15-45 DAS), which is essential for maximizing sesame productivity.

Given the limited research on the integrated effect of clipping and PGR application in sesame, particularly in Gujarat, there is a pressing need to evaluate these agronomic strategies for yield optimization. This study aims to assess the influence of terminal clipping and plant growth regulators on growth, yield attributes, and productivity of sesame under summer conditions in Gujarat.

Materials and Methods

The field experiment was carried out on the plot no. C-7 during summer 2022 and summer 2023, at the Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh. Junagadh is situated at 21.50 N latitude and 70.50 E longitudes with an altitude of 60 m above the mean sea level on the western side at the foothills of Mount Girnar. Junagadh is situated in South Saurashtra Agro-climatic Zone of Gujarat state, which is considered as oil bowl of the country and enjoys a typically subtropical climate characterized by fairly cold and dry winter, hot and dry summer and warm and moderately humid monsoon. The soil of the experimental plot was clayey in texture (in both the years), medium in organic carbon (5.2 and 5.9 g/kg in 2022 and 2023, respectively), slightly alkaline in reaction with pH (7.9 and 8.1 in 2022 and 2023, respectively) and EC (0.44 and 0.41 dS/m in 2022 and 2023, respectively). The soil was medium in available nitrogen (278 and 276 kg/ha in 2022 and 2023, respectively), medium in available phosphorus (38.48 and 36.89 kg/ha in 2022 and 2023, respectively) and medium in available potash (252 and 260

kg/ha in 2022 and 2023, respectively). The experiment consisted of 24 treatment combinations, arranged in a factorial randomized block design with three replications. The factor comprised two clipping treatments (no clipping and clipping at 45 DAS), while the second factor included three plant growth regulator (PGR) treatments (water spray, GA₃ @ 200 ppm, and IAA @ 200 ppm at 50 DAS each) and third weed management treatments (weedy check, pendimethalin 0.50 kg/ha PE, quizalofop-p-ethyl 0.05 kg/ha PoE at 20 DAS, and pendimethalin 0.50 kg/ha PE *fb* quizalofop-p-ethyl 0.05 kg/ha PoE at 30 DAS).

Results and Discussion

Plant height at 45 DAS

Clipping

A detailed examination of the data (Table 1) revealed that in both the research study years and the pooled results, with clipping or without clipping did not significantly affect plant height at 45 DAS.

Plant growth regulators

Plant height at 45 DAS was not significantly affected by foliar application of plant growth regulators at 45 DAS, according to data given in Table 1.

Weed management

An examination of data presented in Table 1 pointed out that application of pendimethalin 0.50 kg/ha as pre-emergence *fb* quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 30 DAS (W₄) recorded significantly highest plant height at 45 DAS over rest of the weed management practices during both the year as well as in pooled analysis.

Interaction effect

The interaction effect of clipping, plant growth regulators and weed management on plant height at 45 DAS was found non-significant (Table 1).

Table 1: Effect of clipping, plant growth regulators and weed management on plant height of summer sesame

Treatments	Plant height at 45 DAS (cm)			Plant height at harvest (cm)		
	2022	2023	Pooled	2022	2023	Pooled
Clipping (C)						
C ₁ : No clipping	24.30	26.34	25.32	67.00	69.57	68.29
C ₂ : Clipping at 45 DAS	24.79	26.05	25.42	54.72	58.29	56.50
S.E.m±	0.48	0.31	0.28	0.79	0.77	0.55
CD (P=0.05)	NS	NS	NS	2.24	2.21	1.55
Plant Growth Regulators (G)						
G ₁ : Water spray at 50 DAS	24.26	26.32	25.29	58.66	61.53	60.09
G ₂ : GA ₃ 200 ppm at 50 DAS	25.38	26.59	25.98	63.02	65.98	64.50
G ₃ : IAA 200 ppm at 50 DAS	23.99	25.67	24.83	60.90	64.29	62.59
S.E.m±	0.58	0.38	0.35	0.96	0.95	0.68
CD (P=0.05)	NS	NS	NS	2.74	2.70	1.90
Weed Management (W)						
W ₁ : Weedy check	21.64	22.84	22.24	59.05	60.80	59.93
W ₂ : Pendimethalin 0.50 kg/ha PE	24.53	26.48	25.50	61.65	65.42	63.54
W ₃ : Quizalofop-p-ethyl 0.05 kg/ha PoE at 20 DAS	24.17	26.41	25.29	59.64	64.36	62.00
W ₄ : Pendimethalin 0.50 kg/ha PE <i>fb</i> Quizalofop-p-ethyl 0.05 kg/ha PoE at 30 DAS	27.83	29.05	28.44	63.11	65.14	64.12
S.E.m±	0.67	0.43	0.40	1.11	1.10	0.78
CD (P=0.05)	1.92	1.23	1.12	3.16	3.12	2.19
CV%	11.64	7.02	9.47	7.74	7.27	7.50
CxW	NS	NS	NS	NS	NS	NS
CxG	NS	NS	NS	NS	NS	3.10
GxW	NS	NS	NS	NS	NS	NS
CxWxG	NS	NS	NS	NS	NS	NS
C x Y			NS			NS

G x Y			NS			NS
W x Y			NS			NS
C x G x Y			NS			NS
C x W x Y			NS			NS
G x W x Y			NS			NS
C x G x W x Y			NS			NS

Plant height at harvest

Clipping

It is evident from data presented in Table 1 that clipped plants at 45 DAS recorded significantly less plant height at harvest as compared to no clipped plants (C_1) during both the years of the experimentation as well as in pooled analysis.

Plant growth regulators

Significantly the highest plant height at harvest (63.02, 65.98 and 64.50 cm) was recorded under the foliar application GA_3 200 ppm over control during 1st, 2nd year and in pooled mean. The pooled mean plant height at harvest observed with GA_3 200 ppm spray was 10.19 per cent higher over control (Table 1).

Weed management

An examination of data presented in Table 1 pointed out that application of pendimethalin 0.50 kg/ha *fb* quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 30 DAS (W_4) significantly increased the plant height at harvest over control of the weed management practices during both the years as well as in pooled analysis. This treatment remained statistically at par with pendimethalin 0.50 kg/ha as pre-emergence (W_2) and quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 20 DAS (W_3) during both years of study and in pooled analysis. The pooled mean plant height at harvest recorded with application of pendimethalin 0.50 kg/ha as pre-emergence *fb* quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 30 DAS (W_4) was 6.33 per cent higher over W_1 .

response aligns with the physiological adaptation of the plant to allocate resources toward lateral branching development and reproductive growth, which might have enhanced yield attributes despite reduced height. Similar results were reported by Siddagangamma *et al.* (2018) [3], Kharbade *et al.* (2017) [4] and Patel *et al.* (2016) [5].

Significantly higher values of plant height at harvest were observed with the foliar application of GA_3 @ 200 ppm at 50 DAS as compared to the control (water spray). However, the results were statistically at par with the foliar spray of 200 ppm IAA during both individual years and in the pooled analysis at harvest. The significant increase in plant height with the application of growth regulators might be due to their growth promoting action as they stimulate the cell division in the meristematic tissue and increase vegetative growth of plant. The application of growth promotive substances increased the plant height and such effect was due to increased photosynthetic activity, enhancement in the mobilization of photosynthates and change in the membrane permeability (Shukla *et al.*, 1997) [6]. The increased plant height might also be due to catalytic action of plant growth regulators on morpho-physiological processes. The increased plant height might also be due to the stimulating action of auxin (IAA) which softens the cell wall by increasing its plasticity or may be the oxidative decarboxylation of synthetic auxins which could not be catalyzed by the enzyme peroxidase.

The foliar application of GA_3 remaining at par with IAA produced significantly higher number of branches per plant at harvest and dry matter accumulation at 60 DAS and at harvest. This could be attributed to the fact that PGRs are reported to enhance physiological activities like cell division, cell elongation, photosynthesis and translocation of nutrients and photosynthates in different crops. Dry matter production and partitioning is a crucial yield-contributing characteristics. The yield is an ultimate expression of different metabolic processes of the plant. The growth regulators might have affected the internal metabolic processes of plant. The PGRs increased plant height as well as number of leaves, which might have contributed to higher dry matter accumulation, increased photosynthetic activity and thus the supply of food (Photosynthates) which resulted in an increased dry matter accumulation in capsules and seeds. Dry matter production and its partitioning towards reproductive parts is an important yield attributing character and a basic vegetative phase is essential for the development of reproductive parts. Although, the dry matter production in general is an inductive of the efficiency of genotype, the pattern in which it is distributed in different plant parts that to more towards the reproductive parts would give a better understanding of its productivity potential. The application of nutrients and plant growth regulators helps in improving the canopy structure and productivity through the manipulation of source-sink relationship. These findings align with the research of Sandbhor (2001) [7], Kothule *et al.* (2003) [8] and Vikas *et al.* (2017) [9].

Table 2: Interaction effect of clipping and plant growth regulators on plant height at harvest of summer sesame (pooled)

Treatments Plant growth regulators	Clipping	
	C_1	C_2
G_1	57.19	55.77
G_2	63.01	58.22
G_3	62.37	55.52
S.E.m±	0.98	
CD (P=0.05)	3.10	

Interaction effect

The pooled data presented in Table 2 revealed that interaction effect between clipping and plant growth regulators found significant on plant height at harvest. Significantly higher plant height at harvest (63.01 cm) was obtained under treatment combination C_1G_2 (no clipping and foliar spray of GA_3 200 ppm at 50 DAS) as compared to other treatments and it remained statistically at par with the treatment combination C_1G_3 on pooled basis. The lowest plant height at harvest (55.52 cm) was registered with treatment combination C_2G_3 .

The pooled data on plant height at harvest indicated that non-clipped plants resulted in significantly taller plants (68.29 cm) as compared to clipping done at 45 DAS (56.50 cm). The reduction in plant height with clipping is attributed to the removal of the apical dominance, leading to restricted vertical growth. This

Table 3: Effect of clipping, plant growth regulators and weed management on number of branches per plant at 60 DAS and harvest of summer sesame

Treatments	No. of branches/plant at 60 DAS			No. of branches/plant at harvest		
	2022	2023	Pooled	2022	2023	Pooled
Clipping (C)						
C ₁ : No clipping	3.52	3.48	3.50	3.97	4.29	4.13
C ₂ : Clipping at 45 DAS	3.78	3.82	3.80	4.94	5.20	5.07
S.Em±	0.05	0.06	0.04	0.07	0.05	0.04
CD (P=0.05)	0.15	0.17	0.11	0.20	0.15	0.12
Plant Growth Regulators (G)						
G ₁ : Water spray at 50 DAS	3.53	3.49	3.51	4.28	4.56	4.42
G ₂ : GA ₃ 200 ppm at 50 DAS	3.77	3.76	3.77	4.63	4.85	4.74
G ₃ : IAA 200 ppm at 50 DAS	3.68	3.65	3.67	4.46	4.83	4.65
S.Em±	0.06	0.08	0.05	0.08	0.07	0.05
CD (P=0.05)	0.18	0.21	0.14	0.24	0.19	0.15
Weed Management (W)						
W ₁ : Weedy check	3.20	3.04	3.12	3.95	4.08	4.02
W ₂ : Pendimethalin 0.50 kg/ha PE	3.77	3.82	3.80	4.35	4.60	4.47
W ₃ : Quizalofop-p-ethyl 0.05 kg/ha PoE at 20 DAS	3.58	3.49	3.54	4.49	4.85	4.67
W ₄ : Pendimethalin 0.50 kg/ha PE <i>fb</i> Quizalofop-p-ethyl 0.05 kg/ha PoE at 30 DAS	4.09	4.19	4.14	5.04	5.44	5.24
S.Em±	0.07	0.09	0.06	0.10	0.08	0.06
CD (P=0.05)	0.21	0.25	0.16	0.28	0.22	0.17
CV%	8.49	10.14	9.35	9.27	6.83	8.07
Interactions						
CxW	NS	NS	NS	NS	NS	NS
CxG	NS	NS	NS	NS	NS	0.25
GxW	NS	NS	NS	NS	NS	NS
CxWxG	NS	NS	NS	NS	NS	NS
C x Y			NS			NS
G x Y			NS			NS
W x Y			NS			NS
C x G x Y			NS			NS
C x W x Y			NS			NS
G x W x Y			NS			NS
C x G x W x Y			NS			NS

Number of branches per plant at 60 DAS**Clipping**

Data furnished in Table 3 indicated that clipping treatment exhibited significant influence on number of branches per plant at 60 DAS. Clipping at 45 DAS (C₂) produced significantly higher number of branches per plant during individual years and in pooled results (3.80/plant) as compared to no clipping (C₁). The clipping at 45 DAS (C₂) increased the mean number of branches per plant to the extent of 7.89 per cent over C₁ (no clipping).

Plant growth regulators

The number of branches at 60 DAS influenced significantly due to foliar application of 200 ppm GA₃ at 50 days after sowing. The treatment of GA₃ (3.77/plant) recorded significantly higher number of branches per plant, which remained statistically at par with the treatment of IAA at 50 DAS (G₃) during first year, second year and in pooled analysis (Table 3)

Weed management

The critical scanning of data presented in Table 3 indicated that significantly highest number of branches per plant (4.09, 4.19 and 4.14/plant) was recorded with application of pendimethalin 0.50 kg/ha as pre-emergence *fb* quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 30 DAS (W₄) as compared to rest of the weed management treatments during both the years and in pooled analysis.

Interaction effect

The interaction effect of clipping, plant growth regulators and weed management on number of branches per plant at 60 DAS

was found non-significant during both the years and in pooled analysis (Table 3).

Number of branches per plant at harvest**Clipping**

A reference to data presented in Table 3 showed that clipping brought about perceptible improvement in number of branches per plant at harvest. The clipping treatment at 45 DAS recorded significantly more number of branches per plant at harvest (4.94, 5.20 and 5.07) over control (no clipping) during both the years and on pooled mean basis.

Plant growth regulators

It was clear from the data (Table 3) that numbers of branches per plant of sesame were significantly affected by various treatments of plant growth regulators during individual years of study and in pooled analysis. The foliar application of GA₃ 200 ppm at 50 DAS (G₂) obtained significantly higher number of branches per plant (4.63, 4.85 and 4.74) as compared to control and remained at par with IAA 200 ppm at 50 DAS (G₃) during 1st year, 2nd year and pooled basis.

Weed management

The number of branches per plant of sesame crop affected by weed management during both years and in pooled analysis (Table 3). Significantly higher number of branches per plant at harvest was found under treatment of pendimethalin 0.50 kg/ha as pre-emergence *fb* quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 30 DAS (W₄) as compared to rest of the weed management treatments during both the years and in pooled analysis.

Interaction effect

The pooled data presented in Table 4 indicated that significant interaction was observed between clipping and plant growth regulators on number of branches per plant. Significantly higher number of branches per plant (5.15) was obtained under treatment combination C₂G₂ (clipping at 45 DAS and foliar spray of GA₃ 200 ppm at 50 DAS) over all other treatment combinations.

Table 4: Interaction effect of clipping and plant growth regulators on number of branches per plant (Pooled)

Treatment	No. of branches per plant at harvest	
	C ₁	C ₂
G ₁	4.09	4.16
G ₂	3.97	5.15
G ₃	4.44	4.09
S.Em±	0.10	
CD (P=0.05)	0.25	

Clipping treatments resulted in significantly higher number of branches per plant as compared to no clipping at 60 DAS. The increase in number of branches with clipping might be due to removal of apical portion of main shoot resulted in more secondary branches because distribution of carbohydrates towards the lateral auxiliary buds below the clipped portion. Clipping also activated the dormant lateral buds to produce more secondary branches. In sesame plants, the development of axillary buds is inhibited normally by Indole Acetic Acid produced in the apical portion of plant. If the source of auxin is removed by removing the apical meristem through clipping, the lateral branching gets activated and accelerated and resulted in more branches per plant. These results are in accordance with the findings of Aziz (2002), Sharma *et al.* (2003) and Dhaka *et*

al. (2018) [11].

Dry matter accumulation at 60 DAS

Clipping

Data furnished in Table 5 indicated that clipping treatment exhibited significant influence on dry matter accumulation. Terminal clipping done at 45 DAS (C₂) produced significantly higher dry matter accumulation during individual years and in pooled results (9.49 g/plant) as compared to no clipping (C₁). The clipping at 45 DAS (C₂) increased the mean dry matter per plant to the extent of 10.74 per cent over no-clipping (C₁).

Plant growth regulators

A further reference to data in Table 5 revealed that dry matter accumulation per plant (g) of sesame were significantly affected by various treatments of plant growth regulators during individual years of study and in pooled analysis. The foliar application of GA₃ 200 ppm at 50 DAS (G₂) significantly increased the dry matter accumulation per plant (9.09, 9.24 and 9.17) as compared to water spray and remained at par with IAA 200 ppm at 50 DAS (G₃) during 1st, 2nd year and pooled basis. The increase in dry matter accumulation per plant with the application of GA₃ 200 ppm at 50 DAS (G₂) and IAA 200 ppm at 50 DAS (G₃) was 5.56 and 4.93 per cent, respectively over control.

Weed management

The critical scanning of data presented in Table 5 indicated that significantly increased the dry matter accumulation was recorded with application of pendimethalin 0.50 kg/ha as pre-emergence *fb* quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 30 DAS (W₄), which remained at par with pendimethalin 0.50 kg/ha as pre-emergence (W₂) during first year.

Table 5: Effect of clipping, plant growth regulators and weed management on dry matter accumulation per plant of summer sesame

Treatments	Dry matter accumulation at 60 DAS (g/plant)			Dry matter accumulation at harvest (g/plant)		
	2022	2023	Pooled	2022	2023	Pooled
Clipping (C)						
C ₁ : No clipping	8.42	8.51	8.47	12.29	12.42	12.35
C ₂ : Clipping at 45 DAS	9.44	9.54	9.49	14.45	14.53	14.49
S.Em±	0.10	0.12	0.08	0.16	0.18	0.12
CD (P=0.05)	0.29	0.34	0.22	0.45	0.51	0.33
Plant Growth Regulators (G)						
G ₁ : Water spray at 50 DAS	8.64	8.68	8.66	12.82	12.97	12.89
G ₂ : GA ₃ 200 ppm at 50 DAS	9.09	9.24	9.17	13.73	13.83	13.78
G ₃ : IAA 200 ppm at 50 DAS	9.06	9.15	9.11	13.56	13.62	13.59
S.Em±	0.12	0.14	0.10	0.19	0.22	0.15
CD (P=0.05)	0.36	0.41	0.27	0.55	0.63	0.41
Weed Management (W)						
W ₁ : Weedy check	7.88	8.06	7.97	11.74	11.70	11.72
W ₂ : Pendimethalin 0.50 kg/ha PE	9.49	9.31	9.40	14.14	13.79	13.96
W ₃ : Quizalofop-p-ethyl 0.05 kg/ha PoE at 20 DAS	8.46	8.81	8.63	12.65	13.33	12.99
W ₄ : Pendimethalin 0.50 kg/ha PE <i>fb</i> Quizalofop-p-ethyl 0.05 kg/ha PoE at 30 DAS	9.89	9.93	9.91	14.96	15.07	15.01
S.Em±	0.14	0.17	0.11	0.22	0.25	0.17
CD (P=0.05)	0.41	0.47	0.31	0.63	0.72	0.47
CV%	6.84	7.83	7.36	7.03	7.99	7.53
Interactions						
CxW	NS	NS	NS	NS	NS	NS
CxG	NS	NS	NS	NS	NS	0.6
GxW	NS	NS	NS	NS	NS	NS
CxWxG	NS	NS	NS	NS	NS	NS
C x Y			NS			NS
G x Y			NS			NS
W x Y			NS			NS
C x G x Y			NS			NS
C x W x Y			NS			NS
G x W x Y			NS			NS
C x G x W x Y			NS			NS

However, in second year of experimentation as well as in pooled analysis it was significant over control (W_1), pendimethalin 0.50 kg/ha as pre-emergence (W_2) and quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 20 DAS (W_3). On pooled basis, increase in the dry matter accumulation due to pendimethalin 0.50 kg/ha as pre-emergence *fb* quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 30 DAS (W_4) was 26.78, 7.14 and 12.5 per cent over water spray (W_1), pendimethalin 0.50 kg/ha as pre-emergence (W_2) and quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 20 DAS (W_3), respectively.

Interaction effect

The interaction effect of clipping, plant growth regulators and weed management on dry matter accumulation at 60 DAS was found non-significant in pooled analysis (Table 5).

Dry matter accumulation at harvest

Clipping

It is evident from data presented in Table 5 that clipping treatment exhibited significant influence on dry matter accumulation. The clipping done at 45 DAS (C_2) produced significantly higher dry matter accumulation during individual years and in pooled results (14.49 g/plant) as compared to without clipping (C_1). The clipping at 45 DAS (C_2) increased the mean dry matter per plant to the extent of 14.76 per cent over no clipping (C_1).

Plant growth regulators

Significantly the highest dry matter accumulation at harvest (13.73, 13.83 and 13.78 g/plant) was recorded under the foliar application of GA₃ 200 ppm at 50 DAS (G_2) over control but remained at par with IAA 200 ppm at 50 DAS (G_3) in individual years as well as in pooled analysis. The foliar application of GA₃ and IAA each 200 ppm increased the dry matter accumulation to the tune of 6.45 and 5.15 per cent, respectively over control at harvest.

Weed management

It is obvious from data presented in Table 4.9, graphically depicted in indicated that the treatment of pendimethalin 0.50 kg/ha as pre-emergence *fb* quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 30 DAS (W_4) recorded significantly higher dry matter accumulation at harvest (14.96, 15.07 and 15.01 g/plant) over rest of the weed management treatments during individual years as well as in pooled analysis. The pooled mean dry matter accumulation at harvest was higher by 21.91, 7.0 and 13.43 per cent due to pendimethalin 0.50 kg/ha as pre-emergence *fb* quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 30 DAS (W_4) as compared to weedy check (W_1), pendimethalin 0.50 kg/ha as pre-emergence (W_2) and quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 20 DAS (W_3), respectively.

Interaction effect

It is evident from data (Table 6) that interactive effect between clipping and plant growth regulators ($C \times G$) was found significant with regard to dry matter accumulation per plant at harvest during pooled analysis of experimentation years.

Interaction effect of clipping and plant growth regulators ($C \times G$) on dry matter accumulation per plant

The pooled mean data presented in Table 6 indicated that the interaction effect of clipping and plant growth regulators was found significant with respect to dry matter accumulation per plant at harvest. Maximum weight of dry matter was recorded in

the treatment combination C_2G_2 (14.8) as compared to all other treatment combinations.

Table 6: Interaction effect of clipping and plant growth regulators on dry matter accumulation per plant of summer sesame (Pooled)

Treatments	Dry matter accumulation at harvest (g/plant)	
	C_1	C_2
G_1	12.61	12.14
G_2	13.20	14.80
G_3	12.71	13.52
S.Em±	0.22	
CD (P=0.05)	0.60	

The increased dry matter accumulation can be attributed to the rise in the number of branches per plant, which resulted in a larger plant canopy. This enhanced canopy allowed for more photosynthetic activity, leading to the accumulation of more photosynthates and their partitioning into different parts of the plants, ultimately resulting in higher dry matter accumulation per plant. Additionally, the clipping treatment likely improved the utilization of available resources, further boosting photosynthesis and dry matter production. These findings are consistent with the research of Kauser *et al.* (2018) ^[10], who reported that clipping of the apical bud provided plants with ample opportunity for photosynthesis, thereby increasing the number of branches and overall plant spread.

Application of pendimethalin 0.50 kg/ha as pre-emergence followed by quizalofop-p-ethyl 0.05 kg/ha as post-emergence at 30 DAS (W_4) resulted in the highest plant height, number leaves per plant, number of branches per plant and dry matter accumulation per plant. This increase might be due to the effective reduction of weed growth, which minimizes crop-weed competition during the critical stages of crop growth. By reducing competition for resources such as light, nutrients, and water, these herbicide treatments helped in enhancing the growth attributes of the crop. The increased plant height in the treated plots reflects improved resource availability and utilization due to effective weed control. Similar findings were reported by Dhaka *et al.* (2015) ^[11], Mane *et al.* (2017) ^[12] and Sujithra *et al.* (2018) ^[13].

Dry matter accumulation was significantly impacted by weed management practices. The combination of pendimethalin at 0.50 kg/ha as a pre-emergence treatment, followed by quizalofop-p-ethyl at 0.05 kg/ha as a post-emergence treatment at 30 DAS (W_4), recorded the highest values across both the years. The suppression of weed growth under treatment W_4 minimized competition for light and nutrients, thereby enhancing photosynthetic efficiency and resource allocation to biomass production. The improved dry matter accumulation under effective weed management is indicative of better vegetative growth and overall plant vigour. The likely reason for this improvement is that the combined application of pendimethalin and quizalofop-p-ethyl resulted in the least number of weeds, reducing competition between the crop and weeds. This observation is consistent with the findings of Gnanavel and Anbhazhagan (2006) ^[14] and Mane *et al.* (2017) ^[12]. In contrast, the weedy check recorded the lowest dry matter accumulation, reflecting the adverse effects of unchecked weed competition, which diverted resources away from the crop and towards the weeds.

Conclusion

Based on the results obtained from two years of

experimentation, it can be concluded that implementing clipping procedure at 45 days after sowing, combined with foliar spray of GA₃ @ 200 ppm at 50 days after sowing found effective in enhancing growth attributes of summer sesame. Additionally, the sequential application of pendimethalin 0.50 kg/ha as pre-emergence followed by quizalofop-p-ethyl 0.05 kg/ha as post-emergence herbicide at 30 days after sowing, recorded the highest growth of summer sesame under irrigated conditions in South Saurashtra.

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