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Morpho-Physiological Responses of Seed Pelleting and Crop Establishment Methods on Phonology, Growth, Physiology and Productivity of Sesame (*Sesamum indicum* L.)

Deepak Sen[1], R.K. Samaiya[1], Yogendra Singh[2*] and Rohit Kumar Kumawat[1]
[1]*Department of Plant Physiology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur-482004 M.P.*
[2]*Dept. of Plant Breeding and Genetics, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur 482004 M.P.*
**Author for Correspondence Email : yogendrasinghbt@gmail.com*

Abstract

Sesame (*Sesamum indicum* L.) is commonly known as 'Til' also called as "Queen of oil seeds". It is belong to family pedaliaceae, and origin place is Africa. Sesame seed is used as an ingredient in several food products and animal feed, whereas its oil is medicinally important for application in pharmaceutical industry. A field experiment was conducted during kharif season of the year 2019 at Experimental Research farm, P.C. unit, Sesame and Niger (AICORP), JNKVV, Jabalpur (M.P.). The experiment consisted of 10 treatment combinations comprising of five main plot treatments of crop establishment methods *viz.*,Farmer's practice (M_1), Dibbling in flat bed (M_2), Dibbling in ridges and furrows (M_3), Drum seeding (M_4), Seed drill sowing (M_5) and two sub plot treatments of seed pelleting *viz.,* Non pelleted (S_1), Pelleted (Neem leaf powder 760g + 120g Azospirillum + 120g phosphobacteria For 1 kg of seed with rice gruel as adhesive) (S_2) and their interactions were laid on split plot design with three replications. The present experiment concluded that the crop establishment methods the M_3-Ridge and furrow method of sowing in sesame crop record early field emergence, early 50 % flowering and physiological maturity also which is attributed maximum dry matter production, growth analytical traits viz.; highest LAI (5.54), LAD (86.83), CGR (0.041), RGR (0.094) NAR (0.0082) RWC (82.53 %), Chlorophyll contents (38.46), plant height (148.71 cm) and number of branches (7.10), yield and yield attributes, maximum seed (2.13 g plant^{-1}) and biological yield(8.65 g plant^{-1}) of crop. Seed pelleting also improved crop growth, dry matter production, LAI, LAD, CGR, NAR, RWC, Chlorophyll contents, plant height and number of branches, yield and yield attributes and yield of crop. Interaction treatment M_3S_2-Ridges and furrows method of sowing and seed pelleting has significantly early field emergence, 50 % flowering and physiological maturity and improved the growth, dry matter production, LAI, LAD, CGR, RWC, Chlorophyll contents, plant height and number of branches, yield and yield attributes and yield of crop.

Key words : *Sesame, seed pelleting, crop establishment, plant height, chlorophyll contents.*

Introduction

Sesame (*Sesamum indicum* L.) is an important oilseed crop grown in India.It is belong to family pedaliaceae, and origin place is Africa. Sesame seeds are rich in oil, proteins, unsaturated fatty acids, vitamins, minerals, and folic acid. The seed contains 50–60% oil which has an excellent stability due to the presence of natural antioxidants such as sesamolin, sesamin and sesamol.

Sesame is very sensitive crop to a biotic stress like water logging and is grown in the arid and semi arid region the productivity of crop is severely affected due to water logging conditions in the irrigated areas. Generally, the crop is sown on flat field and is irrigated through flood irrigation so a considerable number of plants get wilted and ultimately die to water logging conditions. Seed showed maximum germination when stored at moistures (1). Sesame is a low water use crop and is unique in its ability to reserve late season moisture for the following crop. Planting techniques are the most important aspects of advanced production technology which not only ensures better crop establishment but also results in efficient irrigation water utilization, especially when the crop is sown on ridges or beds (2). Sowing of sesame on beds and also on ridges produce higher number of capsules per plant and more seed weight, because plants on beds have suitable spacing for light penetration and this arrangement may also reduce competition among the plants. (3,4) found higher growth parameters and yield in ridge and furrow system over flat sowing system. Similar trends reported by (5).

One of the most promising techniques that can be adopted in direct sown small seeded crops like sesame, onion, lettuce is seed pelleting.Seed pelleting is the method of seed treatments to adding inert materials to seeds increasing their weight, size and shape. Which modifies the germination traits, accelerate germination, improve seedling establishment and enhance plant growth in helping the seed to germinate ina healthy and fertile environment. It provides macro and micronutrients essential for seedling establishment and protects the plants from pest and diseases during the early stages of

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Table-1 : Effect of crop establishment methods, seed pelleting and their interaction onphenophaseson sesame crop.

S. No.	Treatments	Days to Field emergence	Days to 50% flowering	Days to capsule emergence	Days to seed development	Days to physiological maturity	Days to harvest maturity
				Main plot			
1	M_1	4.83	40.35	50.83	62.40	87.83	96.33
2	M_2	4.37	39.63	50.32	61.40	85.68	96.22
3	M_3	4.03	37.30	47.78	60.67	84.23	94.83
4	M_4	4.70	38.68	48.30	61.65	86.10	95.50
5	M_5	4.42	38.55	49.40	61.75	87.33	94.43
	SEm ±	0.033	0.030	0.032	0.053	0.059	0.034
	CD (5%)	0.108	0.098	0.106	0.176	0.196	0.114
				Sub plot			
1.	S_1	4.59	39.02	49.50	61.27	86.48	95.67
2.	S_2	4.35	38.79	49.15	61.36	85.99	95.24
	SEm ±	0.009	0.016	0.028	0.015	0.025	0.034
	CD (5%)	0.108	0.051	0.090	0.049	0.079	0.107
				Interaction			
1	M_1xS_1	4.93	40.43	51.10	62.30	88.07	96.40
2	M_1xS_2	4.73	40.27	50.57	62.50	87.60	96.21
3	M_2xS_1	4.47	39.73	50.10	61.30	86.06	96.43
4	M_2xS_2	4.27	39.53	50.23	61.50	85.30	96.03
5	M_3xS_1	4.23	37.37	48.10	60.23	84.40	95.41
6	M_3xS_2	3.83	37.23	47.47	60.50	84.07	94.27
7	M_4xS_1	4.83	38.83	48.40	61.80	86.40	95.62
8	M_4xS_2	4.57	38.53	48.20	61.50	85.80	95.42
9	M_5xS_1	4.47	38.73	49.50	60.70	87.47	94.57
10	M_5xS_2	4.37	38.37	49.30	60.80	87.20	94.30
	SEm ±	0.046	0.042	0.045	0.075	0.084	0.048
	CD (5%)	0.069	0.117	0.204	0.112	0.0182	0.243

its growth. (6) reported that seed germination and root colonization of sesame were significantly improved when the sesame seeds were pelleted and consequently the grain yield was increased by 10.2%. Seed priming also serves to maintain seed physical quality, like other treatments, yet it also has the potential to reduce farmers risk of poor seedling emergence under variable and uncertain moisture conditions. Hence the experiment was conducted with the Objective to find out the Investigation of the effect of seed pelleting on phonological developments, growth, physiology and productivity of Sesame.

Materials and Methods

A field experiment was conducted during kharif season of the year 2019 at Experimental Research farm, P.C. unit, Sesame and Niger (AICORP), JNKVV, Jabalpur (M.P.). Total five main plot treatments of crop establishment methods viz., Farmer's practice (M_1), Dibbling in flat bed (M_2), Dibbling in ridges and furrows (M_3), Drum seeding (M_4), Seed drill sowing (M_5) and two sub plot treatments of seed pelleting viz., Non pelleted (S_1), Pelleted (Neem leaf powder 760g + 120g Azospirillum + 120g phosphobacteria. For 1kg of seed with rice gruel as adhesive) (S_2) and their interactions were laid on split plot design with three replications. Theexperimental field is situated at 23' 90" N longitude and 79' 58"E longitude at an altitude of 411.78 meter above the mean sea level. It falls under subtropical climatic conditions and the mean annual rainfall of the area is 1284 mm and nearly 90% of the total annual rainfall is mainly received during the period between ends of June to end of September. The maximum and minimum temperature ranges between 24°C to 45°C, and 4°C to 32°C, respectively within a year. In some of the years, maximum temperature reaches as high as 45°C in the month of May or June, while minimum temperature falls 2°C down to a limit of 4°C during end of December or January months. The relative humidity ranges between 80 to 90% during rainy season, which reduces as 60 to 70 and 30 to 40% during winter and summer seasons respectively. Seed treatment was done in the form of pelleted (Neem leaf powder 760 g +120 g Phospho-bacteria for 1 kg of seed with rice gruel as adhesive) Seeds and the sowing. The observations wererecorded on three randomly selected and tagged plants from treatment and replication for the following parameters. The phonological observations of sesame

Table-2 : Effect of crop establishment methods, seed pelleting and their interaction ontotal dry matter production (g plant^{-1}) at different growth stage in sesame crop.

S.No.	Treatments	Total Dry matter production (g plant^{-1})				
		30 DAS	45 DAS	60 DAS	75 DAS	At harvest
			Main plot			
1.	M_1	1.36	2.65	5.86	9.21	9.81
2.	M_2	1.46	2.93	6.53	10.01	10.93
3.	M_3	1.66	3.85	7.87	12.23	13.13
4.	M_4	1.55	3.02	6.67	11.35	11.85
5.	M_5	1.59	3.22	7.12	11.94	12.24
	SEm±	0.002	0.003	0.002	0.005	0.003
	CD (5%)	0.007	0.009	0.006	0.015	0.009
			Sub plot			
1.	S_1	1.51	3.11	6.79	10.92	11.62
2.	S_2	1.54	3.16	6.83	10.97	11.86
	SEm±	0.002	0.001	0.002	0.002	0.002
	CD (5%)	0.006	0.005	0.008	0.007	0.005
			Interaction			
1.	M_1xS_1	1.35	2.63	5.84	9.24	9.85
2.	M_1xS_2	1.37	2.66	5.87	9.97	9.87
3.	M_2xS_1	1.45	2.90	6.51	10.5	10.91
4.	M_2xS_2	1.48	2.94	6.55	12.21	10.94
5.	M_3xS_1	1.64	3.84	7.85	12.25	13.10
6.	M_3xS_2	1.67	3.86	7.89	11.33	13.15
7.	M_4xS_1	1.55	2.96	6.65	11.36	11.83
8.	M_4xS_2	1.56	3.07	6.68	11.93	11.86
9.	M_5xS_1	1.57	3.21	7.08	11.95	12.22
10.	M_5xS_2	1.61	3.24	7.15	0.006	12.26
	SEm ±	0.003	0.003	0.003	0.017	0.004
	CD (5%)	0.014	0.011	0.017	9.24	0.012

crop were noted from five selected plants through daily visual observations throughout the growth periods. Morphological growth parameters *viz.,* plant height and number of branches at 30, 45, 60, 75 DAS and maturity stage. Physiological growth parameters were record *viz.,* plant biomass, LAI, LAD, CGR, RGR, NAR, RWC and chlorophyll content index by Chlorophyll meter (CCM-200) were analysed during different crop growth periods.

Results and Discussion

In the present study, the phenophasic development was significant influenced by different crop establishment methods. The treatment M_3-Ridge and furrow method of sowing was noted in minimum days to field emergence (4.03), days to taken 50 % flowering (37.30), days to capsule emergence(47.78), days to seed development (60.37), days to physiological maturity (84.23) and days to harvest maturity (94.83) as compared to other crop establishment method.

The seed pelleting varied significantly to phenophasic development. The minimum days to field emergence (4.35), days to taken 50 % flowering (38.79), days to capsule emergence (49.15), days to seed development (61.27), days to physiological maturity (85.99) and days to harvest maturity (95.24) was noted in S_2 pelleting as compared to S_1-non pelleting. (2) also concluded that plants of primed seeds took fewer days to emerge and reached earlier flowering and maturity than plants of non-primed seeds.

All the phenophases record earlier in treatment combination of M_3S_2. However, the maximum days was recorded under treatment M_1S_1. The findings are in agreement with the results of (7) reported that the seed treated with $ZnSO_4$ @ 300 mg/kg of seeds recorded higher field emergence percentage (91%) than untreated seeds of tomato. (8) also reported that osmo-priming with $CaCl_2$ reduced emergence time, flowering and maturity times, leading to increased seed yield and seed weight in linseed.

Dry matter production (g plant^{-1}) : The dry matter production was significantly affected at different growth stages by crop establishment methods and seed pelleting and their interaction. Dry matter production plant^{-1} ranged from 9.85 g -13.15 g plant^{-1} at harvest. With respect to crop establishment method and seed pelleting significant difference was observed on dry matter production g plant^{-1}

Table-3 : Effect of crop establishment methods, seed pelleting and their interaction on Leaf Area Index (LAI) and Leaf Area Duration (LAD) (m.2 days) in sesame crop.

S.N.	Treatments	Leaf Area Index (LAI)					Leaf Area Duration (LAD) (m^2 days)				
		30 DAS	45 DAS	60 DAS	75 DAS	At harvest	30 DAS	45 DAS	60 DAS	75 DAS	At harvest
				Main plot					Main plot		
1.	M_1	1.23	1.93	3.47	4.45	3.74	22.60	33.44	55.67	80.40	58.64
2.	M_2	1.35	2.25	3.84	5.07	3.92	24.46	35.36	58.25	82.34	60.24
3.	M_3	1.96	2.95	4.63	5.34	4.74	30.15	39.40	62.26	86.83	66.18
4.	M_4	1.58	2.64	4.11	5.06	4.14	26.39	36.25	60.15	84.24	61.55
5.	M_5	1.87	2.73	4.15	5.17	4.27	28.30	37.80	61.55	85.09	64.25
	SEm±	0.007	0.002	0.002	0.005	0.002	0.023	0.012	0.022	0.47	0.002
	CD (5%)	0.023	0.007	0.006	0.016	0.007	0.076	0.038	0.072	1.56	0.007
				Sub plot					Sub plot		
1.	S_1	1.58	2.49	4.02	5.00	4.14	26.34	36.42	59.55	83.69	62.14
2.	S_2	1.62	2.52	4.05	5.04	4.18	26.43	36.48	59.60	83.87	62.20
	SEm±	0.002	0.003	0.002	0.003	0.001	0.009	0.003	0.002	0.001	0.003
	CD (5%)	0.007	0.005	0.005	0.008	0.004	0.027	0.011	0.008	0.003	0.009
				Interaction effect					Interaction		
1.	M_1xS_1	1.22	1.92	3.45	4.43	3.71	22.50	33.41	55.64	80.35	58.62
2.	M_1xS_2	1.25	1.94	3.49	4.46	3.76	22.70	33.47	55.69	80.45	58.66
3.	M_2xS_1	1.33	2.23	3.83	5.06	3.90	24.43	35.33	58.22	82.31	60.21
4.	M_2xS_2	1.37	2.27	3.85	5.08	3.93	24.48	35.38	58.28	82.36	60.26
5.	M_3xS_1	1.95	2.92	4.61	5.33	4.71	30.13	39.36	62.24	86.77	66.14
6.	M_3xS_2	1.97	2.97	4.65	5.36	4.76	30.17	39.45	62.28	86.88	66.22
7.	M_4xS_1	1.55	2.61	4.10	5.03	4.11	26.34	36.23	60.13	84.22	61.52
8.	M_4xS_2	1.61	2.66	4.12	5.10	4.16	26.43	36.26	60.18	84. 26	61.57
9.	M_5xS_1	1.84	2.72	4.14	5.15	4.25	28.27	37.75	61.54	84.77	64.22
10.	M_5xS_2	1.89	2.75	4.16	5.18	4.28	28.34	37.85	61.57	85.40	64.27
	SEm±	0.007	0.003	0.002	0.007	0.003	0.033	0.016	0.031	0.67	0.003
	CD (5%)	0.016	0.012	0.012	0.019	0.009	0.027	0.024	0.018	0.007	0.021

of Sesame. Treatment M_3-ridge and furrow method of sowing was noted in maximum dry matter production g plant^{-1}(13.13) as compared to M_1-farmer's practices minimum dry matter production g plant^{-1} (9.86).

Seed pelleting treatments S_2-pelleted seed was noted maximum dry matter production g plant^{-1}(11.86) as compared to S_1 (non pelleting) minimum dry matter production g plant^{-1} (11.62).

However, their interaction has significant effect on dry matter production g plant^{-1}M_1S_1-farmer practice's and non pelleting was noted minimum dry matter production g plant^{-1} (9.85) as compared to treatment M_3S_2-Ridges and furrows method of sowing and seed pelleting recorded maximum dry matter production g plant^{-1} (13.15). Similar results were also reported by (9) soybean depends on its symbionts B rady rhizobium japonicum for effective growth and dry matter production. Phosphate solubilizing bacteria improved nodulation, root and shoot biomass, straw and grain yield and P and N uptake of the soya crop. The results are in close conformity with the findings of (9) reported that the seed pelleting with 250 mg ammonium molybdate + 500 mg ferrous sulphate per kg of seeds was most effective in enhancing plant height, leaf area index and dry matter production in soybean.

Growth analysis traits : In the present study, the different crop establishment method and seed pelleting their interaction was significantly influenced physiological growth analytical traits *viz.,* LAI, LAD, CGR RGR and NAR. LAI, LAD was increased up to 75 DAS or CGR and RGR was increased up to 60 DAS and their after it decreases due to leaf senescence. Similar results were also reported by (10) noted that the senescence of leaves at maturity reduced the CGR, LAI, and LAD and consequently the rate of dry matter accumulation.

Seed priming and foliar spray maximally improved the performance of early sown maize crop which is

Table-4 : Effect of crop establishment methods, seed pelleting and their interaction on Crop Growth Rate (g/cm^2/day) and Relative Growth Rate (g/g/day) in sesame crop.

S.N.	Treatments	Crop Growth Rate (CGR) (g cm^{-2} day^{-1})					Relative Growth Rate (RGR) (g g^{-1} day^{-1})				
		30 DAS	45 DAS	60 DAS	75 DAS	At harvest	30 DAS	45 DAS	60 DAS	75 DAS	At harvest
				Main plot					Main plot		
1	M_1	0.013	0.023	0.034	0.024	0.0075	0.012	0.028	0.084	0.014	0.004
2	M_2	0.017	0.027	0.037	0.026	0.0082	0.014	0.030	0.088	0.015	0.005
3	M_3	0.022	0.031	0.041	0.030	0.0090	0.021	0.032	0.094	0.021	0.007
4	M_4	0.020	0.028	0.038	0.027	0.0086	0.018	0.031	0.091	0.019	0.006
5	M_5	0.021	0.030	0.039	0.029	0.0088	0.019	0.030	0.092	0.019	0.006
	SEm±	0.002	0.003	0.004	0.001	0.0002	0.001	0.002	0.002	0.001	0.0001
	CD (5%)	0.001	0.002	0.001	0.002	0.0001	0.003	0.001	0.001	0.001	0.0002
				Sub plot					Sub plot		
1.	S_1	0.018	0.027	0.037	0.026	0.0084	0.015	0.029	0.089	0.017	0.004
2.	S_2	0.019	0.029	0.038	0.028	0.0089	0.018	0.031	0.091	0.019	0.006
	SEm±	0.003	0.004	0.002	0.003	0.0002	0.003	0.002	0.001	0.003	0.0002
	CD (5%)	0.001	0.002	0.001	0.002	0.0001	0.001	0.002	0.002	0.001	0.0001
				Interaction					Interaction		
1	M_1xS_1	0.012	0.022	0.033	0.023	0.0072	0.010	0.026	0.082	0.014	0.003
2	M_1xS_2	0.014	0.024	0.035	0.025	0.0083	0.013	0.030	0.085	0.015	0.004
3	M_2xS_1	0.016	0.026	0.036	0.026	0.0085	0.011	0.029	0.087	0.014	0.004
4	M_2xS_2	0.019	0.028	0.038	0.027	0.0087	0.016	0.031	0.089	0.016	0.005
5	M_3xS_1	0.021	0.030	0.040	0.028	0.0090	0.019	0.031	0.093	0.019	0.006
6	M_3xS_2	0.024	0.033	0.042	0.031	0.0091	0.023	0.033	0.095	0.022	0.007
7	M_4xS_1	0.019	0.026	0.037	0.026	0.0087	0.016	0.029	0.090	0.018	0.005
8	M_4xS_2	0.021	0.029	0.038	0.028	0.0088	0.019	0.032	0.092	0.020	0.006
9	M_5xS_1	0.020	0.028	0.037	0.027	0.0089	0.018	0.028	0.091	0.018	0.005
10	M_5xS_2	0.022	0.031	0.040	0.030	0.0090	0.020	0.032	0.093	0.019	0.006
	SEm±	0.002	0.002	0.003	0.003	0.0004	0.002	0.001	0.001	0.002	0.0001
	CD (5%)	0.003	0.001	0.002	0.001	0.0002	0.001	0.001	0.002	0.002	0.0002

attributed more likely to improved stand establishment, chlorophyll and phenolic content, increased LAD period, similarly increased chlorophyll contents, CGR and LAI (11). The maximum LAI (5.36) and LAD (86.88) at 75 DAS was recorded under treatment M_3S_2- Ridges and furrows method of sowing and seed pelletingat 75 DAS. The maximum CGR and RGR at 60 DAS were recorded under treatment M_3S_2 at 75 DAS.

The interactions treatment M_1S_1 (farmer practice's and Non pelleting) was noted minimum net assimilation rate (0.0063) as compared to treatment M_3S_2 (ridges and furrows method of sowing and pelleting) maximum net assimilation rate (0.0082). The results are in close conformity the findings of (12) reported that the crop growth rate ant net assimilation rate was higher when crops are planted on ridge and furrow or bed planting system of mustard.

In the present study, ranges for chlorophyll content were found to be 34.23-38.67. With respect the treatment M_3-Ridges and furrows method of sowing was noted in maximum chlorophyll content (38.46) as compared to M_1-Farmer's practice had minimum chlorophyll content (34.40) and seed pelleting on chlorophyll content S_2-seed pelleting was noted maximum chlorophyll content (36.65) as compared to S_1-Non pelleting was minimum chlorophyll content (36.26). However, their interaction has significant effect on chlorophyll content M_1S_1-farmer practice's and Non pelleting was noted minimum chlorophyll content (34.23) as compared to treatment M_3S_2-Ridges and furrows method of sowing and seed pelleting was maximum chlorophyll content (38.67). Similar results were also reported by (13) reported positive and significant correlation of chlorophyll content with yield, confirmed its role towards higher source activity.

The significantly maximum relative water content % (82.53) was recorded under M_3-Ridges and furrows

Table-5 : Effect of crop establishment methods, seed pelleting and their interaction on Net Assimilation Rate (g/cm^2/day), Chlorophyll Content Index and Relative Water Content (%) in sesame crop.

S.N.	Treatments	Net Assimilation Rate (NAR) (g/cm^2/day)					Chlorophyll content index	Relative water content (%)
		30 DAS	45 DAS	60 DAS	75 DAS	At harvest		
				Main plot				
1.	M_1	0.0035	0.0039	0.0052	0.0065	0.0055	34.40	75.36
2.	M_2	0.0042	0.0048	0.0061	0.0078	0.0073	35.45	76.34
3.	M_3	0.0052	0.0063	0.0076	0.0082	0.0074	38.46	82.53
4.	M_4	0.0043	0.0058	0.0072	0.0079	0.0066	36.58	78.23
5.	M_5	0.0050	0.0060	0.0074	0.0080	0.0075	37.38	80.69
	SEm±	0.0001	0.0002	0.0001	0.0003	0.0002	0.020	0.024
	CD (5%)	0.0003	0.0001	0.0002	0.0001	0.0001	0.067	0.078
				Sub plot				
1.	S_1	0.0042	0.0057	0.0065	0.0075	0.0068	36.26	78.55
2.	S_2	0.0051	0.0059	0.0073	0.0078	0.0073	36.65	78.71
	SEm±	0.0002	0.0003	0.0002	0.0002	0.0001	0.018	0.008
	CD (5%)	0.0001	0.0001	0.0003	0.0001	0.0003	0.058	0.026
				Interaction				
1.	M_1xS_1	0.0026	0.0033	0.0052	0.0063	0.0053	34.23	75.25
2.	M_1xS_2	0.0037	0.0045	0.0055	0.0066	0.0054	34.57	75.46
3.	M_2xS_1	0.0044	0.0049	0.0061	0.0074	0.0058	35.17	76.22
4.	M_2xS_2	0.0048	0.0055	0.0064	0.0077	0.0063	35.73	76.46
5.	M_3xS_1	0.0050	0.0060	0.0072	0.0080	0.0071	38.23	82.45
6.	M_3xS_2	0.0052	0.0062	0.0075	0.0082	0.0074	38.67	82.61
7.	M_4xS_1	0.0046	0.0057	0.0071	0.0075	0.0064	36.43	78.16
8.	M_4xS_2	0.0048	0.0060	0.0073	0.0078	0.0067	36.73	78.29
9.	M_5xS_1	0.0050	0.0061	0.0072	0.0079	0.0072	37.23	80.66
10.	M_5xS_2	0.0051	0.0062	0.0074	0.0081	0.0075	37.53	80.74
	SEm±	0.0001	0.0002	0.0001	0.0003	0.0001	0.029	0.033
	CD (5%)	0.0002	0.0003	0.0002	0.0001	0.0002	0.132	0.059

method of sowing. Seed pelleting (S_2) was noted maximum relative water content % (78.61) as compared to S_1 (Non pelleting) minimum relative water content % (78.55). However, their interaction has significant effect on relative water content.

Plant height and number of branches are the important growth parameters of any crop as it determines or modifies the yield contributing characters. The significantly maximum plant height (148.71) and number of branches (7.10) were recorded under treatment M_3-Ridges and furrows method of sowing.The minimum plant height (137.30) and number of branches (5.84) ware noted in M_1-Famer's practice. The result revealed a significant variation due to seed pelleting. The maximum plant height (145.21) and number of branches (6.60) at harvest was noted in S_2- pelleting seeds while, a minimum (144.17) value plant height was observed in S_1-non pelleting. The crop establishment methods of sowing and seed pelleting their interaction influenced plant height at harvest significantly. The combination of M_3S_2 had highest plant height (149.18) and number of branches (7.13) while, the minimum plant height was noted in M_1S_1. The potential to obtain increased plant height on ridge may be expected because ridges have loose soil, more aeration and drainage which is less compacted, have been found to be effective in enhancing maize seed emergence inducing vigour to plant growth (14). In a different study, (15) found that soybean grown on ridges gave the highest number of leaves and tillers, root length, plant height and fresh and dry weight.

The greater grain yield was obtained from ridges and furrows method of sowing than the two other showing methods this might could be due to better growth of plant, higher LAI, LAD, CGR and higher chlorophyll contain index that resulted higher yield and yield attributes and finally to maximum yield. This agrees with 16), mention that ridges are recommended if water logging is a problem. Ridging is commonly practised and the indication is that it could increase grain yield (16) Probably, due to higher bulk densities in flat ground, the

Table-6 : Effect of crop establishment methods, seed pelleting and their interaction on plant height (cm) and number of branches Seed yield (g/plant) and Biological yield (g/plant) in sesame crop.

S.N.	Treatments	Plant height (cm)	Number of branches	Seed yield (g/plant)	Biological yield (g/plant)
		Main plot			
1.	M_1	137.30	5.84	1.35	6.65
2.	M_2	143.99	6.35	1.57	7.63
3.	M_3	148.71	7.10	2.13	8.65
4.	M_4	145.70	6.74	1.62	7.43
5.	M_5	147.83	6.86	1.77	7.75
	SEm±	0.035	0.007	0.016	0.013
	CD (5%)	0.117	0.015	0.054	0.045
		Sub plot			
1.	S_1	144.17	6.55	1.61	7.50
2.	S_2	145.21	6.60	1.76	7.75
	SEm±	0.011	0.004	0.009	0.019
	CD (5%)	0.030	0.009	0.030	0.060
		Interaction			
1.	M_1xS_1	136.55	5.82	1.30	6.43
2.	M_1xS_2	137.84	5.85	1.40	6.87
3.	M_2xS_1	143.43	6.33	1.50	7.57
4.	M_2xS_2	144.54	6.36	1.63	7.73
5.	M_3xS_1	148.24	7.06	2.10	8.77
6.	M_3xS_2	149.18	7.13	2.17	8.85
7.	M_4xS_1	145.27	6.69	1.53	7.33
8.	M_4xS_2	146.15	6.78	1.70	7.53
9.	M_5xS_1	147.35	6.84	1.62	7.67
10.	M_5xS_2	148.32	6.88	1.90	7.83
	SEm±	0.050	0.009	0.023	0.019
	CD (5%)	0.083	0.018	0.069	0.136

pod yields were less than in ridges as a result of unfavourable conditions for peg penetration, pod setting and development in the surface soil layers of flat seed beds. In the present study, seed yield g plant^{-1} ranged from 1.30 g plant^{-1} – 2.17 g plant^{-1}. With respect to crop establishment method and seed pelleting significant difference was observed on seed yield g plant^{-1}of Sesame. Treatment M_3-Ridges and furrows method of sowing was noted in maximum seed yield g plant^{-1}(2.13) and biological yield g plant^{-1}(8.65) as compared to M_1-farmer's practices had minimum seed yield g plant^{-1} (1.35) and biological yield g plant^{-1}(6.65) and seed pelleting on seed yield g plant^{-1} S_2-Pelleted was noted maximum seed yield g plant^{-1}(1.76) and biological yield g plant^{-1} (7.75) as compared to S_1 (Non pelleting) minimum seed yield g plant^{-1} (1.61) and biological yield g plant^{-1}(7.50).

However, their interaction has significant effect on seed yield g plant^{-1}M_1S_1-Farmer practice's and Non pelleting was noted minimum seed yield g plant^{-1} (1.30) and biological yield g plant^{-1} (6.43) as compared to treatment M_3S_2-(Ridges and furrows method of sowing and seed pelleting had maximum seed yield g plant^{-1} (2.17) and biological yield g plant^{-1} (8.85). (17) with seed production of summer groundnut observed significantly higher field emergence, number of nodules per plant, pods per plant, seed yield per plant and biological yield per plant with polythene mulch (7 mm thickness) over raised bed method. (4) found higher growth parameters, yield and yield attributes parameters in ridge and furrow system over flat sowing system in soybean. Similar trends reported by (5).

Conclusions

The present experiment concluded that the crop establishment methods the M_3-Ridge and furrow method of sowing in sesame crop record early field emergence, 50 % flowering and physiological maturity.Seed pelleting also improved crop growth, dry matter production, LAI, LAD, CGR, RWC, Chlorophyll contents, plant height and number of branches, yield and yield attributes and yield of crop.

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