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Seed Enhancement Techniques to Improve Productivity of Certain Oilseed Crops

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Dr. G. Sathiya Narayanan, Dr. M. Prakash and Dr. B. Sunil Kumar: Seed Enhancement Techniques to Improve Productivity of Certain Oilseed Crops

Abstract: The present investigations were conducted at the Department of Agricultural Botany, Faculty of Agriculture, Annamalai University to study the influence of various seed enhancement techniques such as halogenation treatment, pesticide treatment and pelleting treatment on productivity of three major oilseed crops viz., sesame, sunflower and groundnut. The seed enhancement techniques include dry dressing with thiram @ 2 g kg^{-1}, slurry treatment with thiram @ 2 g kg^{-1}, dry dressing with halogen mixture @ 3 g kg^{-1} of seed for sesame and sunflower and 4 g kg^{-1} for groundnut kernel, slurry treatment with halogen mixture @ 3 g kg^{-1} of seed for sesame and sunflower and 4 g kg^{-1} for groundnut kernel, pelleting with arappu, neem and pungam leaf powder, and vasambu rhizome powder @ 200 g kg^{-1} of seed along with control. All the treated seeds were evaluated for yield and productivity under irrigated condition. The halogen slurry treatment registered significantly higher values for field stand, plant height, number of branches, chlorophyll content, pod yield, seed yield, 100 seed weight, leaf area, relative growth rate and net assimilation rate for all the three crops. In addition to the above characters, the halogen slurry treatment recorded higher values in capsule morphological characters for sesame, head morphological characters for sunflower and pod morphological characters for groundnut. This has also recorded enhanced seed yield and seed quality such as oil content, germination percentage, seedling length, dry matter production and vigor index when compared to control in all three oilseed crops.

Key words: Sesame, Sunflower, Groundnnt, Pelleting, Halogenation, Leaf powder.

Introduction

Oilseeds, the raw material for vegetable oil, occupy a significant place in India's economy. Next to food grains, oilseeds account for 10 per cent of the cultivated area and value of all agricultural produce. Nearly 85 per cent of the oil and fat needs of the country is primarily met by vegetable oils. India is the third largest producer of oilseeds in the world. No other country has its range of perennial and annual oilseeds. In terms of area, India ranks first in groundnut, sesame, linseed, safflower, niger and castor. Although India has 20.8 per cent of the world's area under oilseeds, it accounts for less than 10 per cent of world's production. In terms of vegetable oils, India is the fourth largest oil economy in the world after the U.S, China and Brazil. Favourable agro-ecological conditions in the country have supported commercial cultivation of seven annual edible and two non edible oilseed crops, besides a number of minor oilseeds of horticultural and forest origin, including in particular coconut and oil palm. With the growing population along with raising per capita income, the demand for vegetable oil is likely to grow unabated in the coming years. The impact of green revolution has made our country self sufficient in the production of cereals. The situation so far as oilseeds are concerned is not very bright. Although India is one of the world's largest producer of oil seeds, the quantity of edible fat available falls far short of the country's requirement.

Seed being the basic input in agriculture, production and supply of quality seeds to the farmers will go a long way to achieve the goal of self sufficiency in oilseed crops. Very often the seed may retain the required germination standard but its vigour, which is yet to be quantified and productivity. Seed pelleting or coating is the most applicable technique in direct sown crops which need initial vigour for sustained crop growth and development. Coating provides an opportunity to package effective quantities of materials such that they can

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influence micro environment of each seed which supplies not only micro and macro nutrients but also protects the crop from pests and diseases from the earlier stages due to the inclusion of Pesticides. Because of increased awareness of organic farming, use of plant products in agricultural research is gaining importance. Seed coating is an important area in which plant materials could be widely used. To increase the productivity, various pre-sowing seed treatment methods are followed but such treatments have not come into practice among farmers because of the non-availability of the chemicals to the marginal and small farmers and they are also expensive.

Hence, an attempt was made to explore the use of easily available materials for pelleting to increase germination and seedling growth in early phase. Researchers are recommending several pre-sowing seed management techniques with the benefit of invigoration, protection and production (Gopal Singh and Ramarao, 1993; Sevanan, 1988). Among the various seed treatments, the physical seed treatments *viz*., pesticide seed treatment, seed colouring, seed coating and seed pelleting are widely under the usage by the seed producers and are normally included as a continuous treatment in sequencing the various post harvest seed handling techniques. Basu (1990) revealed that the seed treatment implies an improvement in seed performance resulting in better field performance than the corresponding untreated seed and the establishment of a seedling in the soil is an important and foremost need for the better crop production. This depends largely on the germination and vigour potential of the seeds used for sowing. Seed treatment provides an opportunity to package effective quantities of materials such that they can influence micro environment of each seed which supplies not only micro and macro nutrients, but also protects the crop from pests and diseases from the earlier stages due to the inclusion of pesticides. To increase the productivity of the oilseeds, various physical seed enhancement techniques were followed but such treatments have not come into practice among farmers because of the non-availability of the chemicals to the marginal and small farmers and they are also expensive. With this background, experiments have been conducted to study the influence of physical seed enhancement techniques such as halogenation, fungicidal and pelleting on productivity of sesame cv VRI 1, sunflower cv Morden and groundnut cv VRI 2 kernels.

Materials and methods

Genetically pure seeds of sesame (*Sesamum indicum*) cv. VRI 1, Groundnut cv. VRI 2 and Sunflower cv. Morden obtained from the Oilseed Research Station, Virudhachalam and Agricultural Research Station, Bhavanisagar formed the base material for the study. The bulk seeds were graded for uniformity using appropriate round perforated metal sieves of sizes *viz*., 5/64" for Sesame, 9/64" for Sunflower and 18/64" for Groundnut kernels. The field experiments were conducted at the Department of Agricultural Botany, Annamalai University, Annamalai Nagar (11°24'N latitude and 79°44'E longitude with an altitude of +5.79 mts above mean sea level). The seeds of above oilseed crops were imposed with the following physical seed enhancement techniques.

T_0 - Control
T_1 - Dry dressing with Thiram @ 2 g kg^{-1} of seed.
T_2 - Slurry treatment with Thiram @ 2 g kg^{-1} of seed.
T_3 - Dry dressing with Halogen mixture @ 3 g kg^{-1} of seed for sesame and sunflower and 4 g kg^{-1} for groundnut
T_4 - Slurry treatment with Halogen mixture @ 3 g kg^{-1} of seed for sesame and sunflower and 4 g kg^{-1} for groundnut as slurry.
T_5 - Pelleting with Arappu leaf powder @ 200 g kg^{-1} of seed.
T_6 - Pelleting with Neem leaf powder @ 200 g kg^{-1} of seed.
T_7 - Pelleting with Pungam leaf powder @ 200 g kg^{-1} of seed.
T_8 - Pelleting with Vasambu rhizome powder @ 200 g kg^{-1} of seed.

The treatments were evaluated for field stand, plant height, number of branches, pod yield, seed yield, 100 seed weight, seedling length, dry matter production, for all the three crops. In addition to the above characters, capsule morphological characters for sesame, head morphological characters for sunflower and pod morphological characters for groundnut were also observed. The experiments were conducted for two consecutive years, their average values were worked out and subjected to statistical analysis. The physiological parameters such as chlorophyll content, leaf area index, relative growth rate, net assimilation rate, germination % and vigour index were also evaluated using following methods. Chlorophyll content (Yoshida *et al.,* 1976).

A quantity of 250 mg of leaf tissue (third leaf from top) was homogenised with 80 per cent acetone and centrifuged at 3000 rpm for 10 minutes. The supernatant was collected and made upto 250 ml with 80 per cent acetone. The optical density of the extract was read in a spectronic 20 using 652 nm for total chlorophyll using 80 per cent acetone as blank. The total chlorophyll content was computed using the formula and expressed as mg g^{-1} of fresh leaf.

Total chlorophyll content = $\frac{OD\ value\ at\ 652\ nm \times 1000 \times V}{34.5 \times 250 \times 1000} \times 100$

Where V=final volume of acetone extract Leaf area All the leaves in a plant were removed in randomly selected five plants plot^{-1} at peak flowering stage and the leaf area was measured in a portable leaf area meter-AM 300 and the mean area of leaves was expressed in cm^{2} plant^{-1}.

3. Relative Growth Rate (RGR):

RGR is defined at any instant of time (t) as the increase in dry weight per unit dry material present. This can be determined by measuring plant dry weight periodically during growth and is commonly represented as g g^{-1} day^{-1}.

$$RGR = \frac{Log_e W_2 - Log_e W_1}{t_2 - t_1}$$

Where W_1 & W_2 are the plant dry weights at times t_1& t_2 respectively.

Net Assimilation Rate (NAR):

NAR is defined as the increase in plant dry weight per unit of assimilatory surface per unit time. NAR can be determined by measuring plant dry weight and leaf area periodically during growth and is commonly reported as g cm^{-2} day^{-1}.

$$NAR = \frac{(W_2 - W_1)(Log_e A_2 - \log_e A_1)}{(t_2 - t_2)(A_2 - A_1)}$$

Where, W_1 & W_2 are the plant dry weights at times t1 and t2 respectively and A_1 and A_2 are the leaf areas at times t_1 and t_2 respectively.

5. Oil Estimation (AOAC, 1960):

The seeds were de coated and the kernels from each sample were dried at 105°C in a hot air oven for 16 h. Then, they were allowed to cool in a dissector. From, this about 5g of the seed was taken, ground in a porcelain mortar and transferred to an extraction thimble. The thimble was then placed inside the Soxhlet extractor to which sufficient quantity of ether solvent was added and heated for 6 h. until 6 to 8 siphoning were completed. Then the extraction flask with the siphoning was taken out and placed in a hot air oven maintained at 60°C to evaporate the ether completely. The percentage of oil content was than calculated by using the following formula. The determination of oil content was duplicated for each sample and expressed in %.

Oil % = $\frac{Oil\ weight\ (g)}{Sample\ weight\ (g)} \times 100$

6. Germination Percentage (ISTA, 1999):

The germination test was carried out as per ISTA in a germination room maintained at 25±2^{o}C and 90±5% RH., using four replicates of hundred seeds in each of the crop using paper medium for sesame and sunflower and sand medium for groundnut. A germination period of 6 days for sesame, 7 days for sunflower and 10 days for groundnut were observed as per ISTA. After the test period, the normal seedlings were counted and the mean values were expressed as percentage.

7.Vigour Index (VI):

The Vigour Index values were computed as per Abdul-Baki and Anderson (1973) adopting the following procedure and the mean was expressed as whole number.

VI – Germination percentage x Total seedling length in cm

Results
Sesame cv VRI 1:

Highly significant results were obtained for all the yield attributing characters *viz*., field stand, plant height, number of branches, chlorophyll content, capsule number/plant, length of capsule, breadth of capsule, weight of capsule, weight of capsule/plant, 1000 seed weight, leaf area (Table 1), relative growth rate and net assimilation rate (Table 2). The seed yield and the seed quality characters *viz*., seed yield/plant, seed yield/plot, seed yield/ha, oil content, germination percentage, seedling length, drymatter production and vigour index also recorded highly significant influence for the evaluated physical seed enhancement techniques (Table 3 and Fig. 1).

Growth Characters:

The field stand was the highest with T_4 (92%) which was on par with T_3(91%). However, the lowest value was recorded in T_0 (80%). The plant height was lowest in the plants grown with untreated control seeds, T_0 (89 cm), while it was highest with T_4 (105 cm) followed by T_3 (102 cm). The seed crop raised with T_4 produced the maximum number of branches (6.7) which was on par with T_3 (6.3), while it was minimum with untreated control T_0 (4.3).

Physiological Characters:

Chlorophyll content recorded maximum with T_4 (2.09 mg.g^{-1}) and it was on par with T_3 (2.07 mg.g^{-1}) and minimum with T_0 (1.54mg.g^{-1}). The maximum leaf area was recorded in T_4 treatment (896 cm^2. plant^{-1}) which was on par with T_3 (888 cm^2. plant^{-1}) and the minimum leaf area was found in T_0 (633 cm^2. plant^{-1}). The relative growth rate of the treated seeds of sesame varied significantly due to treatments and interactions between days and treatments. Relative growth rate (RGR), estimated during various growth durations, revealed that the rates were low initially (0.266 g.g.day^{-1}) and, as the growth advanced towards maturity, there was abundant increase in the rates of growth (0.598 g.g.day^{1}) (Table.2). Among the treatments, T_4 recorded 0.348 g.g.day^{-1} RGR during 15-30 DAS when compared to control (0.189 g.g.day^{-1}) and it maintained the lead over other treatments in every successive stages upto harvest.

The net assimilation rate of the treated seeds of sesame varied significantly due to treatments and interactions between days and treatments. Net assimilation rate, recorded during various growth durations, revealed that the rates were low initially (0.0.99 mg cm^{-2}.day^{-1}) and, as the growth advanced towards maturity, there was greater increase in the rates of growth (0.174 mg cm^{-2}.day^{-1}) (Table. 3). Among the treatments, T_4 recorded 0.126 mg.cm^{-2}day^{-1} NAR during 15-30 DAS when compared to control (0.057 mg cm^{-2}.day^{-1}) and it maintained the lead over other treatments in every successive stages upto harvest.

Yield Characters:

The maximum number of capsule per plant was recorded with T_4 (133) and it was on par with T_3(131) and it was reduced to minimum with $T_{0,}$ the control (86). The maximum length of capsule was recorded with T_4 (25.3mm), which was on par with T_3 (24.7mm) and the minimum length of capsule was found in T_0(20.7mm). The maximum breadth of capsule was recorded with T_4 (6.3mm), which was on par with T_3 (6.2mm) and the minimum length of capsule was found in T_0(4.5mm). The maximum weight of capsule was recorded in T_4 treatment (22.8 g) which was on par with T_3 (22.5 g) and the minimum weight was found in T_0 (18.3 g). The maximum 1000 seed weight was recorded in T_4 treatment (3.8 g) which was on par with T_3 (3.8 g) and the minimum was found in T_0 (3.01 g). The maximum seed yield was recorded in T_4 treatment (9.33g) which was on par with T_3(9.25g) and the minimum was recorded in control, T_0 (7.24 g). The maximum seed yield per plot was recorded in T_4(811 g) which was on par with T_3(805 g) and the minimum (645 g) was recorded in control (T_0). The maximum seed yield per ha^{-1} was recorded in T_4 (819 kg) which was on par with T_3 (813 kg) and the minimum (575 kg) was recorded in control (T_0). The oil content was the highest T_4 (49.3 per cent) which was on par with T_3 (48.9 per cent),while the lowest value was recorded by T_0 (48.3 per cent).

Seedling Characters:

The germination percentage was the highest T_4 (92 per cent) which was on par with T_3 (92 per cent), while the lowest value was recorded byT_0 (83 per cent). The maximum root length was recorded in T_4 (9.7 cm) which was on par with T_3 (9.6 cm) and the minimum (8.4 cm) was recorded in control (T_0). The maximum shoot length was recorded in T_4 (8.6 cm) which was on par with T_3 (8.5 cm) and the minimum (6.1 cm) was recorded in control (T_0). The maximum drymatter production was recorded in T_4 (2.2 mg.10 seedlings^{-1}) which was on par with T_3(2.1 mg.10 seedlings^{-1}) and the minimum (1.7 mg.10 seedlings^{-1}) was recorded in control (T_0). The maximum vigour index was recorded in T_4 (1678) which was on par with T_3(1677) and the minimum (1201) was recorded in control (T_0).

2. Sunflower Cv Morden:

Highly significant results were obtained for all the characters *viz*., (Table. 4), field stand, plant height, number of leaves, leaf area, chlorophyll content, head diameter, number of rows/head, 100 achene weight, head to seed ratio, relative growth rate and net assimilation rate (Table 5). The seed yield and the seed quality characters *viz*., seed weight/head, seed yield/plot, seed yield/ha, oil content, germination percentage, seedling length, drymatter production, and vigour index also recorded highly significant values for the evaluated physical seed enhancement techniques (Table 6 and Fig. 1).

Growth Characters:

The field stand was the highest with T_4 (92%) which was on par with T_3(90%). However, the lowest value was recorded in T_0 (75%). The plant height was lowest in the plants grown with untreated control seeds T_0 (58 cm), while it was highest with T_4 (80 cm), which was on par with T_3(77 cm). The seed crop raised with T_4 recorded the maximum value (18.7) which was on par with T_3 (18.3), while it was minimum with untreated control, T_0 (15.3).

Physiological Characters:

The maximum leaf area was recorded in T_4 treatment (3110 cm^2. plant^{-1}) which was on par with T_3 (3098 cm^2. plant^{-1}) and the minimum leaf area was found in T_0 (2562 cm^2. plant^{-1}). Chlorophyll content recorded maximum with T_4 (0.188 mg. g^{-1}) and it was on par with T_3 (0.186 mg. g^{-1}) and minimum with T_0 (0.145 mg. g^{-1}). The relative growth rate of the treated seeds of sunflower varied significantly due to treatments and interactions between days and treatments. Relative growth rate (RGR), recorded during various growth durations, revealed that the rates were low initially (0.133 g.g.day^{-1}) and, as the growth advanced there was abundant increase in the rates of growth (0.611 g.g.day^{1})(Table. 6). Among the treatments, T_4 recorded 0.151 g.g.day^{-1} RGR during 20-40 DAS when compared to control (0.115 g.g.day^{-1}) and it maintained the same trend in every successive stages up to harvest. The net assimilation rate of the treated seeds of sunflower differed significantly due to treatments and interactions between days and treatments. Net assimilation rate, estimated during various growth durations, revealed that the rates were low initially (0.106 mg cm^{-2}.day^{-1}) and, as the growth advanced towards maturity, there was abundant increase in the rates of growth (0.182 mg cm^{-2}.day^{-1}) (Table 7). Among the treatments, T_4 recorded 0.138 mg.cm^{-2}day^{-1} NAR during 20-40 DAS when compared to control (0.063 mg cm^{-2}.day^{-1}) and it maintained the lead over other treatments in every successive stages up to harvest. The relative growth rate of the treated seeds of sunflower varied significantly due to treatments and interactions between days and treatments. Relative growth rate (RGR), recorded during various growth durations, revealed that the rates were low initially (0.133 g.g.day^{-1}) and, as the growth advanced there was abundant increase in the rates of growth (0.611 g.g.day^{1}) (Table. 6). Among the treatments, T_4 recorded 0.151 g.g.day^{-1} RGR during 20-40 DAS when compared to control (0.115 g.g.day^{-1}) and it maintained the same trend in every successive stages up to harvest.

Yield Characters:

The maximum head diameter was recorded with T_4 (17.0 cm) and it was on par with T_3(16.9 cm) and it was reduced to minimum with T_0, the control(11.0 cm). The maximum number of rows/head was recorded with T_4 (94), which was on par with T_3 (92) and the minimum number of rows was found in T_0 (73). The maximum achene weight was recorded in T_4(7.2 g) which was on par with T_3(7.1 g) and the minimum (3.7 g) was recorded in control (T_0). The maximum head to seed ratio was recorded in T_4 treatment (76 %) which was on par with T_3 (75 %) and the minimum ratio was found in T_0 (55%). The maximum seed weight/head was recorded with T_4 (72.7 g), which was on par with T_3 (70.0 g) and the minimum was found in T_0 (50.7 g). The maximum seed yield plot^{-1} was recorded in T_4 treatment (47.6 kg) which was on par with T_3(47.3 kg) and the minimum was recorded in control, T_0 (27.6 kg). The maximum seed yield ha^{-1} was recorded in T_4(1786 kg) which was on par with T_3(1760 kg) and the minimum (1276 kg) was recorded in control (T_0). The oil content was the highest in

T_4 (43.2 per cent) which was on par with T_3 (43.1 percent), while the lowest value was recorded by T_0 (42.8 per cent).

Seedling Characters:

The percentage germination was the highest T_4 (93 per cent) which was on par with T_3(92 per cent),while the lowest value was recorded by T_0 (77 per cent). The maximum root length was recorded in T_4 (19.4 cm) which was on par with T_3(19.3 cm) and the minimum (16.1 cm) was recorded in control, (T_0). The maximum shoot length was recorded in T_4(19.0 cm) which was on par with T_3(18.8 cm) and the minimum (12.2 cm) was recorded in control, (T_0). The maximum drymatter production was recorded in T_4(358 mg.10 seedlings^{-1}) which was on par with T_3(357 mg.10 seedlings^{-1}) and the minimum (258 mg.10 seedlings^{-1}) was recorded in control (T_0). The maximum vigour index was recorded in T_4 (3573) which was on par with T_3(3565) and the minimum (2270) was recorded in control (T_0).

3. Groundnut cv VRI 2:

Highly significant values were obtained for all the characters studied *viz*., (Table 7), field stand, plant height, number of primary branches, chlorophyll content, pod number/plant, fresh weight of pods/plant, dry weight of pods/plant, 100 pod weight, 100 seed weight, leaf area, relative growth rate and net assimilation rate (Table 8). The seed yield and the seed quality characters *viz*., seed yield/plant, seed yield/plot, seed yield/ha, shelling percentage, oil content, germination percentage, seedling length, dry matter production, and vigour index also recorded significant values for all the evaluated physical seed enhancement techniques (Table 9 and Fig. 1).

Growth Characters:

The field stand was the highest with T_4 (93%) which was on par with T_3 (92%). However, the lowest value was recorded in T_0 (81%). The plant height was lowest in the plants grown with untreated control seeds T_0 (19.1 cm) while it was highest with T_4 (29.4 cm), which was on par with T_3 (28.8 cm). The seed crop raised with T_4 recorded the maximum value (4.7) which was on par with T_3(4.3), while it was minimum with untreated control, T_0 (2.7).

Physiological Characters:

Chlorophyll content recorded maximum with T_4 (2.93 mg. g^{-1}) and it was on par with T_3 (2.91 mg. g^{-1}) and minimum with T_0 (1.85 mg. g^{-1}). The maximum leaf area was recorded in T_4 treatment (1042 cm^2. plant^{-1}) which was on par with T_3 (1009 cm^2. plant^{-1}) and the minimum leaf area was found in T_0 (887 cm^2. plant^{-1}). The relative growth rate of the treated seeds of groundnut varied significantly due to treatments and interactions between days and treatments. Relative growth rate (RGR), estimated during various growth durations, revealed that the rates were low initially (0.020 g.g.day^{-1}) and, as the growth advanced there was abundant increase in the rates of growth (0.092 g. g. day^{-1}) (Table 10). Among the treatments, T_4 recorded 0.025 g.g.day^{-1} RGR during 15-30 DAS when compared to control (0.011 g.g.day^{-1}) and it maintained the same trend in every successive stages upto harvest.The net assimilation rate of the treated seeds of groundnut varied significantly due to treatments and interactions between days and treatments. Net assimilation rate, recorded during various growth stages, revealed that the rates were low initially (0.098 mg cm^{-2}.day^{-1}) and, as the growth advanced towards maturity, there was significant increase in the rates of growth (1.036 mg cm^{-2}.day^{-1}) (Table. 11). Among the treatments, T_4 recorded 0.142 mg.cm^{-2}day^{-1} NAR during 15-30 DAS when compared to control (0.042 mg cm^{-2}.day^{-1}) and it maintained the lead over other treatments in every successive stages upto harvest.

Yield Characters:

The maximum pod number was recorded with T_4 (22) and it was on par with T_3 (21) and it was reduced to minimum with T_0, the control (10).The maximum fresh weight of pods/plant was recorded with T_4 (14.13 g), which was on par with T_3 (13.97 g) and the minimum was found in T_0 (9.15g). The maximum dry weight of pods/plant was recorded with T_4 (6.39 g), which was on par with T_3(6.35 g) and the minimum was found in T_0(4.36 g).The maximum 100 pod weight was recorded in T_4 (73.3 g) which was on par with T_3 (71.3 g) and the minimum (48.5 g) was recorded in control, (T_0). The maximum 100 seed weight was recorded in T_4 (46.6 g) which was on par with T_3 (46.3 g) and the minimum (30.8 g) was recorded in control, (T_0). The maximum seed yield/plant was recorded in T_4 treatment (6.04 g) which was on par with T_3 (6.03 g) and the minimum seed yield/plant was found in T_0 (4.05 g).

The maximum seed yield/plot was recorded in T_4 treatment (3.04 kg) which was on par with T_3 (2.97 kg) and the minimum was found in T_0 (1.92 kg). The maximum seed yield per ha^{-1} was recorded in T_4 (1795 kg) which was on par with T_3(1793 kg) and the minimum (1324 kg) was recorded in control, (T_0). The shelling percentage was the highest T_4 (65.0 per cent) which was on par with T_3 (63.6 percent), while the lowest value was recorded by T_0 (58.1 per cent). The oil content was the highest T_4 (46.1 per cent) which was on par with T_3(45.6 per cent),while the lowest value was recorded by T_0 (45.1 per cent).

Seedling Characters:

The percentage germination was the highest T_4 (94 per cent) which was on par with T_3 (93 per cent), while the lowest value was recorded by T_0 (80 per cent). The maximum root length was recorded in T_4 (18.2 cm) which was on par with T_3 (17.8 cm) and the minimum (13.4 cm) was recorded in control, (T_0). The maximum shoot length was recorded in T_4 (20.0 cm) which was on par with T_3 (19.8 cm) and the minimum (16.4 cm) was recorded in control, (T_0). The maximum drymatter production was recorded in T_4 (3.17 g.10 $seedlings^{-1}$) which was on par with T_3 (3.10 g.10 $seedlings^{-1}$) and the minimum (1.80 g.10 $seedlings^{-1}$) was recorded in control, (T_0). The maximum vigour index was recorded in T_4 (3578) which was on par with T_3 (3507) and the minimum (2396) was recorded in control, (T_0).

Plate 1: Physical seed enhancement techniques to sesame cv VRI 1.

Plate 2: Physical seed enhancement techniques to sunflower cv Morden.

Plate 3: Physical seed enhancement techniques to Groundnut cv VRI 2.

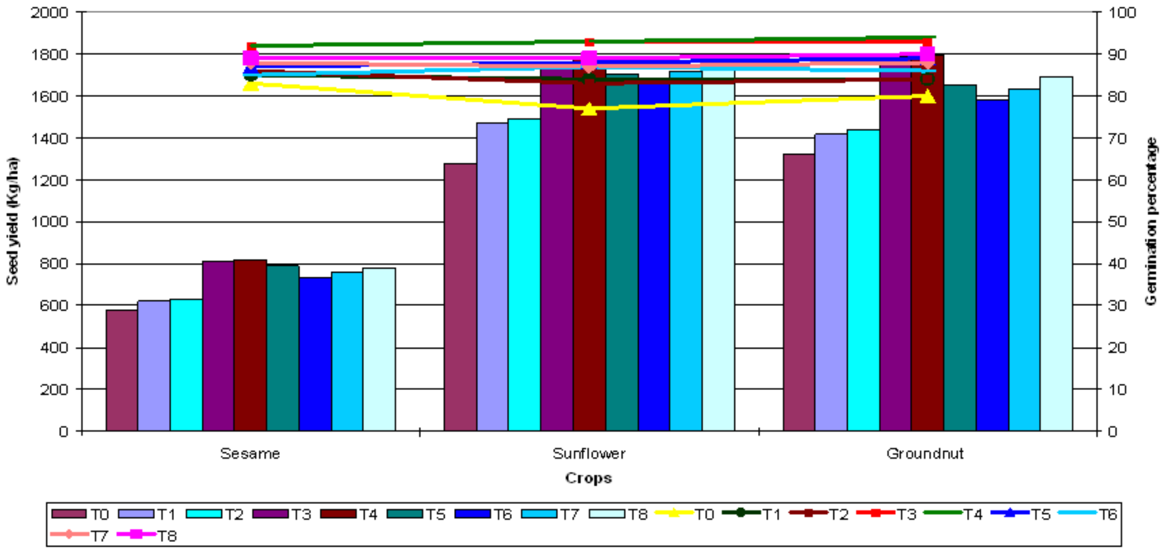

Fig. 1: Influence of physical seed enhancement techniques on seed yeild and germination percentage in certain all seed crops.

Table 1: Influence of physical seed enhancement techniques on various yield attributing characters in sesame cv VRI 1

Treatment	Field stand (%)	Plant height (cm)	Number of branches	Chlorophyll content(mg.g^{-1})	Capsule number plant	Length of capsule (mm)	Breadth of capsule (mm)	Weight of capsule plant (g)	1000 seed weight (g)	Leaf area (cm^2 plant^{-1})
T_0	80 (63.7)	89	4.3	1.54	86	20.7	4.5	18.3	3.01	633
T_1	81 (64.2)	93	4.7	1.68	90	22.0	5.0	19.5	3.16	696
T_2	81 (64.4)	93	5.7	1.70	94	22.3	5.1	20.1	3.17	694
T_3	91 (72.3)	102	6.3	2.07	131	24.7	6.2	22.5	3.48	888
T_4	92 (73.7)	105	6.7	2.09	133	25.3	6.3	22.8	3.48	896
T_5	86 (68.1)	97	5.3	1.98	121	23.3	5.7	19.9	3.31	810
T_6	82 (65.2)	94	4.7	1.82	113	22.0	5.4	19.0	3.23	781
T_7	87 (68.6)	97	5.7	1.92	116	23.7	5.6	19.9	3.20	827
T_8	86 (68.3)	97	5.8	1.98	112	22.3	5.7	20.4	3.28	861
Mean	85 (67.6)	96	5.4	1.87	111	23.03	5.5	20.3	3.27	787
CD (P = 0.05)	2.73	2.57	1.14	0.052	5.56	1.31	0.248	0.599	0.069	18.38

Figures in parenthesis are Arcsine Transformed value

Table 2: Influence of physical seed enhancement techniques on relative growth rate (g g^{-1} day^{-1}) and net assimilation rate (mg. cm^{-2} day^{-1}) of sesame cv VRI 1 at growth intervals

Treatments	Relative Growth Rate (g g^{-1} day^{-1})				Net Assimilation Rate (mg. cm^{-2} day^{-1})			
	Days after sowing				Days after sowing			
	D_1(15-30)	D_2(30-45)	D_3(45-60)	Mean	D_1(15-30)	D_2(30-45)	D_3(45-60)	Mean
T_0	0.189	0.367	0.385	0.314	0.057	0.112	0.153	0.107
T_1	0.195	0.397	0.476	0.356	0.083	0.119	0.161	0.121
T_2	0.206	0.407	0.492	0.368	0.093	0.122	0.167	0.127
T_3	0.314	0.613	0.697	0.541	0.118	0.138	0.187	0.148
T_4	0.348	0.635	0.709	0.564	0.126	0.147	0.196	0.156
T_5	0.285	0.550	0.662	0.499	0.108	0.129	0.175	0.137
T_6	0.276	0.537	0.637	0.483	0.096	0.124	0.172	0.131
T_7	0.288	0.547	0.652	0.495	0.106	0.131	0.175	0.138
T_8	0.295	0.568	0.672	0.512	0.102	0.128	0.178	0.136
Mean	0.266	0.513	0.598	0.459	0.099	0.128	0.174	0.133
	D	T	D x T		D	T	D x T	
CD (P = 0.05)	0.001	0.002	0.003		0.00086	0.00149	0.00258	

Table 3: Influence of physical seed enhancement techniques on seed yield and seed quality characters in sesame cv VRI 1

Treatment	Seed yield /plant (g)	Seed yield /plot (g)	Seed yield /ha (kg)	Oil content (%)	Germination percentage	Root l ength (cm)	Shoot length (cm)	Dry matter production (mg. 10 seedlings^{-1})	Vigour index
T_0	7.24	645	575	48.3 (44.03)	83 (65.4)	8.4	6.1	1.7	1201
T_1	8.13	671	620	48.6 (44.20)	85 (67.2)	9.1	6.9	1.9	1357
T_2	8.11	678	628	48.7 (44.23)	86 (67.8)	8.9	7.1	1.8	1379
T_3	9.25	805	813	48.9 (44.45)	91 (73.9)	9.6	8.5	2.1	1677
T_4	9.33	811	819	49.3 (44.57)	92 (74.0)	9.7	8.6	2.2	1678
T_5	8.64	768	788	48.7 (44.30)	87 (68.9)	9.2	8.2	2.0	1513
T_6	8.41	737	734	48.4 (44.18)	85 (67.5)	8.9	8.0	1.9	1448
T_7	8.80	757	760	48.6 (44.18)	88 (69.4)	9.3	8.3	2.0	1540
T_8	8.94	781	779	48.7 (44.25)	89 (70.6)	9.4	8.2	2.0	1578
Mean	8.54	739	724	48.7 (44.26)	87 (69.4)	9.2	7.77	1.978	1485
CD (P = 0.05)	0.219	10.85	18.85	0.16	1.73	0.254	0.257	0.185	48.37

Figures in parenthesis are Arcsine Transformed value

Table 4: Influence of physical seed enhancement techniques on various yield attributing characters in sunflower cv Morden.

Treatment	Field stand (%)	Plant height (cm)	Number of leaves	Leaf area (cm^{2}. Plant^{-1})	Chlorophyll content (mg.g^{-1})	Head diameter (cm)	Number of rows/head	100 achene weight (g)	Head to seed ratio (%)
T_0	75 (59.80)	58	15.3	2562	0.145	11.0	73	3.7	55
T_1	82 (64.71)	66	16.7	2867	0.155	13.4	80	4.4	64
T_2	83 (65.93)	67	16.3	2943	0.156	13.3	77.6	4.5	66
T_3	90 (71.65)	77	18.3	3098	0.186	16.9	92	7.1	75
T_4	92 (73.30)	80	18.7	3110	0.188	17.0	94	7.2	76
T_5	86	70	17.7	2980	0.181	15.1	85.6	6.4	68

Table 4: Continue.

Treatment	Field stand (%)	Plant height (cm)	Number of leaves	Leaf area (cm^{2}. Plant^{-1})	Chlorophyll content (mg.g^{-1})	Head diameter (cm)	Number of rows/head	100 achene weight (g)	Head to seed ratio (%)
	(68.31)								
T_6	83 (65.92)	68	17.0	2874	0.168	14.4	81	6.1	64
T_7	87 (68.64)	71	17.3	3012	0.176	14.9	84.3	6.5	65
T_8	89 (70.45)	72	17.6	2951	0.180	15.4	86.6	6.4	70
Mean	85 (67.63)	70	17	2933	0.171	14.6	83.8	5.8	67
CD (P =0.05)	2.80	4.86	1.41	97.069	0.0064	0.868	4.069	0.404	0.0466

Figures in parenthesis are Arcsine Transformed value

Table 5: Influence of physical seed enhancement techniques on relative growth rate (g g^{-1} day^{-1}) and net assimilation rate (mg. cm^{-2} day^{-1}) of sunflower cv Morden at growth intervals

Treatments	Relative Growth Rate (g g^{-1} day^{-1})				Net Assimilation Rate (mg. cm^{-2} day^{-1})			
	Days after sowing				Days after sowing			
	D_1(15-30)	D_2(30-45)	D_3(45-60)	Mean	D_1(15-30)	D_2(30-45)	D_3(45-60)	Mean
T_0	0.115	0.380	0.397	0.297	0.063	0.116	0.164	0.114
T_1	0.127	0.398	0.493	0.339	0.087	0.127	0.170	0.128
T_2	0.130	0.409	0.499	0.346	0.098	0.128	0.175	0.134
T_3	0.142	0.625	0.705	0.491	0.128	0.140	0.192	0.153
T_4	0.151	0.649	0.730	0.510	0.138	0.151	0.206	0.165
T_5	0.130	0.565	0.682	0.459	0.115	0.136	0.185	0.145
T_6	0.131	0.551	0.653	0.445	0.105	0.127	0.179	0.137
T_7	0.135	0.542	0.662	0.446	0.107	0.133	0.187	0.142
T_8	0.137	0.574	0.674	0.462	0.113	0.135	0.184	0.144
Mean	0.133	0.521	0.611	0.422	0.106	0.133	0.182	0.140
	D	T	D x T		D	T	D x T	
CD (P = 0.05)	0.001	0.002	0.003		0.001	0.002	0.003	

Discussion:

Researchers are recommending several pre-sowing seed management techniques with the benefit of invigoration, protection and production (Gopal Singh and Ramarao, 1993; Sevanan, 1988). Among the various seed treatments, the physical seed treatments *viz*., pesticide seed treatment, seed colouring, seed coating and seed pelleting are widely under the usage by the seed producers and are normally included as a continuous treatment in sequencing the various post harvest seed handling techniques. Basu (1990) revealed that the seed treatment implies an improvement in seed performance resulting in better field performance than the corresponding

Table 6: Influence of physical seed enhancement techniques on seed yield and seed quality characters in sunflower cv Morden

Treatment	Seed weight/ head (g)	Seed yield / plot (kg)	Seed yield / ha (kg)	Oil content	Germination percentage	Root length (cm)	Shoot length (cm)	Dry matter production (mg. 10 seedlings^{-1})	Vigour index
T_0	50.7	27.6	1276	42.8 (40.84)	77 (61.21)	16.1	12.2	258	2270
T_1	58.7	32.0	1472	43.0 (40.94)	84 (66.32)	17.0	13.4	288	2541
T_2	61.3	35.0	1492	43.0 (40.94)	83 (65.21)	16.9	13.6	290	2547
T_3	70.0	47.3	1760	43.1 (41.01)	92 (75.02)	19.3	18.8	357	3565
T_4	72.7	47.6	1786	43.2 (40.09)	93 (74.35)	19.4	19.0	358	3573
T_5	68.7	39.7	1707	43.0 (40.96)	88 (70.42)	18.1	18.1	331	3202
T_6	65.3	37.3	1659	42.9 (40.96)	87 (68.25)	17.9	16.0	312	2950
T_7	66.7	39.7	1719	43.0 (41.00)	87 (69.34)	18.2	17.6	317	3138
T_8	68.3	39.0	1731	43.0 (41.00)	89 (70.05)	18.6	17.9	336	3257
Mean	64.7	38.4	1622	43.0 (40.90)	87 (69.24)	17.97	16.3	316	3005
CD (P = 0.05)	2.40	3.54	71.67	0.04	3.24	0.499	1.120	21.29	248.48

Figures in parenthesis are Arcsine Transformed value

Table 7: Influence of physical seed enhancement techniques on various yield attributing characters in groundnut cv VRI 2

Treatment	Field stand (%)	Plant height (cm)	Number of primary branches	Chlorophyll content (mg. g^{-1})	Pod number /plant	Fresh weight of pods /plant (g)	Dry weight of pods /plant (g)	100 pod weight (g)	100 seed weight (g)	Leaf area (cm^2 Plant^{-1})
T_0	81 (64.25)	19.1	2.7	1.85	10	9.15	4.36	48.5	30.8	887
T_1	86 (68.34)	22.8	3.0	2.06	14	10.12	4.91	52.8	33.1	903
T_2	85 (67.36)	23.6	3.3	2.16	13	10.22	4.97	54.3	33.8	906
T_3	92 (73.14)	28.8	4.3	2.91	21	13.97	6.35	71.3	46.3	1009
T_4	93 (75.01)	29.4	4.7	2.93	22	14.13	6.39	73.3	46.6	1042
T_5	89 (71.31)	27.5	3.7	2.65	18	13.05	5.45	68.7	40.2	960
T_6	88 (69.26)	26	3.3	2.49	15	12.53	5.18	62.8	37.7	943
T_7	89 (70.16)	27	3.3	2.52	17	12.07	4.98	63.6	38.4	962
T_8	89 (70.06)	27	3.7	2.69	18	12.99	5.10	66.1	38.8	967
Mean	88 (69.81)	25.7	3.5	2.47	16.6	12.02	5.29	62.4	38.4	953
CD (P = 0.05)	3.13	1.70	1.53	0.155	3.04	0.482	0.407	1.84	1.32	5.20

Figures in parenthesis are Arcsine Transformed value

Table 8: Influence of physical seed enhancement techniques on relative growth rate (g g^{-1} day^{-1}) and net assimilation rate (mg. cm^{-2} day^{-1}) of groundnut cv VRI 2 at growth intervals

Treatments	Relative Growth Rate (g g-1 day-1) Days after sowing							Net Assimilation Rate (mg. cm-2 day-1) Days after sowing						
	D1 (15-30)	D2 (30-45)	D3 (45-60)	D4	D5	D6	Mean	D1 (15-30)	D2 (30-45)	D3 (45-60)	D4	D5	D6	Mean
T_0	0.011	0.016	0.018	0.054	0.075	0.080	0.042	0.042	0.169	0.286	0.344	0.571	0.810	0.371
T_1	0.017	0.022	0.025	0.061	0.080	0.088	0.049	0.054	0.180	0.423	0.472	0.649	0.852	0.438
T_2	0.020	0.024	0.026	0.063	0.082	0.090	0.051	0.062	0.182	0.430	0.471	0.654	0.862	0.444
T_3	0.023	0.030	0.034	0.070	0.092	0.096	0.058	0.138	0.334	0.478	0.557	0.794	1.142	0.574
T_4	0.025	0.032	0.036	0.072	0.095	0.097	0.060	0.142	0.346	0.493	0.566	0.830	1.294	0.612
T_5	0.020	0.030	0.031	0.068	0.085	0.095	0.055	0.123	0.314	0.441	0.510	0.737	1.131	0.543
T_6	0.023	0.024	0.027	0.065	0.089	0.092	0.054	0.102	0.292	0.443	0.497	0.797	0.985	0.515
T_7	0.020	0.026	0.030	0.064	0.090	0.093	0.056	0.110	0.299	0.448	0.505	0.698	1.111	0.528
T_8	0.023	0.028	0.031	0.066	0.096	0.094	0.056	0.111	0.303	0.458	0.508	0.784	1.136	0.550
Mean	0.020	0.026	0.029	0.065	0.088	0.092	0.053	0.098	0.0269	0.433	0.492	0.721	1.036	0.508
		D		T		D x T		D	T		D x T			
CD (P = 0.05)	0.001	0.001		0.001		0.003		0.001	0.001		0.004			

untreated seed and the establishment of a seedling in the soil is an important and foremost need for the better crop production. This depends largely on the germination and vigour potential of the seeds used for sowing. Seed treatment provides an opportunity to package effective quantities of materials such that they can influence micro environment of each seed which supplies not only micro and macro nutrients, but also protects the crop from pests and diseases from the earlier stages due to the inclusion of pesticides. To increase the productivity of the oilseeds, various physical seed enhancement techniques were followed but such treatments have not come into practice among farmers because of the non-availability of the chemicals to the marginal and small farmers and they are also expensive.

Table 9: Influence of physical seed enhancement techniques on seed yield and seed quality characters in groundnut cv VRI 2

Treatment	Seed yield / plant (g)	Seed yield / plot (kg)	Seed yield / ha (kg)	Shelling percentage (%)	Oil content (%)	Germination percentage	Root length (cm)	Shoot length (cm)	Dry matter production (g. 10 seedlings^{-1})	Vigour index
T_0	4.05	1.92	1324	58.1 (49.92)	45.1 (42.19)	80 (63.72)	13.4	16.4	1.80	2396
T_1	4.42	2.15	1418	58.6 (49.94)	45.4 (42.34)	84 (66.40)	14.6	17.1	2.21	2660
T_2	4.57	2.18	1438	59.7 (50.85)	45.5 (42.42)	84 (66.53)	14.9	17.2	2.38	2697
T_3	6.03	2.97	1793	63.6 (53.72)	45.6 (42.50)	93 (75.60)	17.8	19.8	3.10	3507
T_4	6.04	3.04	1795	65.0 (52.93)	46.1 (42.76)	94 (74.45)	18.2	20.0	3.17	3578
T_5	5.72	2.44	1656	62.7 (52.31)	45.3 (42.32)	89 (70.30)	16.5	18.9	2.95	3135
T_6	5.41	2.35	1583	62.3 (52.10)	45.5 (42.42)	86 (68.36)	15.4	18.1	2.83	2889
T_7	5.54	2.51	1630	60.3 (50.91)	45.5 (42.40)	88 (70.11)	16.1	18.5	2.77	3057
T_8	5.74	2.67	1692	60.5 (50.28)	45.5 (42.40)	90 (71.62)	16.7	19.1	2.82	3222
Mean	5.28	2.47	1592	61.6 (51.70)	45.5 (42.40)	88 (69.73)	15.7	18.3	2.67	3015
CD (P = 0.05)	0.1577	0.125	48.50	1.85	0.16	2.81	0.708	0.81	0.222	114.7

Figures in parenthesis are Arcsine Transformed value

In the present investigation, field emergence potential differed significantly among the treatments. The field stand per cent of all these crops were the highest with seeds treated with halogen slurry treatment compared to other treatments and control, while the second best was halogen dry treatment. The field stand per cent was 16, 23 and 16 per cent higher than control, respectively in sesame, sunflower and groundnut. The results are in conformity with the findings of Ponnuswamy (1986) in groundnut, Punitha (1996) in vegetable crops, Anbazhagi (1997) in groundnut and Rathnavalli (1998) in sunflower. The increased field emergence observed in the present study might be due to the rapid conversion of the insoluble reserve substances into a soluble state and their mobilization and transport to the regions of intense growth activity by the smaller embryonic axes and larger cotyledons of the halogenated seeds. The seeds subjected with the halogen slurry treatment also recorded higher values for the biometrical and physiological observations *viz*., plant height, number of branches and leaf area which was 18, 53, 42 percentage in sesame, 37, 21, 21 percentage in sunflower and 53, 75, 17 percentage in groundnut, higher than the control irrespective of the above mentioned characters. The relative growth rate (RGR) and net assimilation rate (NAR) also projected similar results. The RGR and NAR are the good measures of physiological gain resulting in growth of the plant indicating the rapidity with which the dry matter accumulated in plants. High RGR and NAR are the positive manifestations of rapid and continued growth effects on plant. In case of halogenated slurry seeds the improvement in RGR at the end of the growth stage was 84, 83, 21 percentage over control in sesame, sunflower and groundnut respectively. The NAR at the end of the growth stage was 45, 24, 60 percentage over control in sesame, sunflower and groundnut respectively. The results are in conformity with the findings of Punitha (1996) in vegetable crops, Anbazhagi (1997) in groundnut and Rathnavalli (1998) in sunflower. This might be due to the invigorative effect of halogen mixture (Chandrasenannair, 1996) and increase in rate of photosynthesis.

In the present study, the halogen slurry treatment recorded higher values for yield attributing characters like breadth of capsule, length of capsule, weight of capsule, chlorophyll content in sesame; head diameter, head to seed ratio, 100 achene weight, chlorophyll content for sunflower; fresh weight of pod, dry weight of pod, chlorophyll content and pod number in groundnut, when compared to the control. The increase was with a tune of 38, 23, 25, 36 percentage in sesame, 54, 37, 86, 21 percentage in sunflower and 54, 46,120, 58 percentage in groundnut respectively with the above-mentioned characters. Chandrasenannair (1996) reported a similar increase in the yield attributing characters due to halogenation in paddy. The increase in the yield attributing characters might be due to the increased germination and vigour of the plants induced by the halogenation treatments. The seed yields recorded by the various treatments of this study were also higher with halogen slurry treated seeds. It recorded 42, 40 and 36 percentage respectively with sesame, sunflower and groundnut. The second best score was obtained with halogen dry treatment. Chandrasenannair (1996) reported such increase in yield due to halogenation in paddy, Punitha (1996) in vegetable crops, Anbazhagi (1997) in groundnut and Rathnavalli (1998) in sunflower. Initial germination, vigour and plant growth induced by the halogen treatments might be the reason for the higher percentage of seed yield observed in the present study. Seed quality is the prime need of any seed production programme. The seed quality characters evaluated through physical, physiological and biochemical characters revealed the superiority of halogen slurry treatment in enhancing these seed quality characters. The enhancement was found to be 2 per cent with oil content, 13 per cent with germination, 15 per cent with root length, 40% with shoot length, 25 per cent with drymatter production and 40 per cent with vigour index in case of sesame when compared to untreated control, while in sunflower the hike was 1 per cent with oil content, 19 per cent with germination, 14 per cent with root length, 26 per cent with shoot length, 25 per cent with drymatter production and 40 per cent with vigour index. In groundnut also, the enhancement was found to the tune of 2 per cent with oil content, 19 per cent with germination, 36 per cent with root length, 22 per cent with shoot length, 76 per cent with drymatter production and 49 per cent with vigour index, when compared to control. The second best treatment was halogen dry treatment for all these three crops.

The results are in conformity with the findings of Basu and Rudrapal (1979) in wheat, jute and mustard, Basu and Rudrapal (1980) in mustard and Rudrapal and Basu (1981) in mustard. The better quality of the halogenation treated seeds of sesame, sunflower and groundnut might be due to the higher initial vigour of the plants induced by the halogen treatments and subsequent accumulation of higher nutrients in the seed. The performance analysis of other seed treatments expressed that among the pelleting treatments, the order of preference would be arappu leaf, vasambu rhizome, pungam leaf and neem leaf powder. The seeds treated with thiram both as dry and slurry were also found to be better than control. The hike in yield and germination over control are as below.

Thus, the various physical seed enhancement techniques on productivity of oilseed crops revealed that seed treatment with halogen mixture as slurry recorded higher seed yield and seed quality when compared to other treatments while the dry dressing with halogen was found to be closely associated with halogen slurry treatment.

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