

The System of Mustard Intensification

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This designation, **System of Mustard Intensification** or SMI, is an afterthought. I found out only recently that my system of transplanting mustard seedlings with wide spacing is similar to the System of Rice Intensification (SRI) developed in Madagascar some 25 years ago and now spreading in India. Both systems depend on low density of crops and seek to utilize the full potentiality of each plant, rather than on communities of plants as done with high-density planting.

The mustard variety that I use is of medium duration, expressing very high yield potential when transplanted with adequate space, good management, and appropriate fertilization, etc. In order to distinguish this variety from other promising varieties, I have given it the name of *Manikya*, which means 'jewel'.

Manikya is a local variety. I first saw this mustard plant in an exhibition held in the year 1984, and it impressed me very much. Its siliques¹ were in clusters, and the plant was fully laden, heavy with the pods. It was awarded the 1st prize in the mustard competition, so I managed to obtain the plant, which contained 150 g of seed. Thus my quest began.

Its remarkable potential was observed when about a thousand plants were transplanted in a F₁ cabbage field as a catch crop in the ratio of 10:2. The catch crop of *Manikya* could tolerate and absorb a fertilizer dose as high as 170-70-70 kg NPK per hectare. It showed no symptoms of over-fertilization and reflected this in an unbelievable yield. The spacing was wide, 60cm x 25cm. Seedlings about 20 days old were transplanted. The computed yield was 35 Q/ha (3.5 t/ha). The year was 1985.

This medium tall variety grows to one meter in height and one meter in breadth – when widely spaced. It is very sturdy and compact, withstanding high fertilization, and it does not lodge and thus is capable of bearing a heavy load of seeds. The leaves are comparatively small and narrow. Its harvest index is high, and plant type is almost ideal. Branches start at a height of 15-20 cm above ground when sown, and 5-10 cm when transplanted, forming at an angle of 45°. Branching is profuse, with about 7 to 10 branches from the main stem.

The sown crop takes 100 to 105 days to mature when sown broadcasted, but with alternative management, it matures in 90-95 days after transplanting, excluding the nursery period. The siliques come in bunches, each silique about 5 cm long, containing about 12-15 brown-coloured seeds. The seeds are rather small as 1000 seed-weight is

¹ Name for the narrow, elongated seed capsule peculiar to the mustard family (Cruciferae).

2.13 gm (440,000 seeds/1kg). But it compensates for this very amply with a very high number of siliques, as high as 2000-3000 per plant.

A single widely-spaced plant may contain more than 100 g of seed, but in community of 50,000 to 70,000 plants/ha, the average performance remains between 40 and 75 gms/plant. This productivity, however, depends on many interacting factors.

As I have mentioned, this variety responds to heavy fertilization, but application of less than 60 kg N/ha may not show any significant yield advantage. In order to achieve its full potential, a suitable package of practices must be followed, which do not differ from other high-yielding varieties, except that this variety can be transplanted very beneficially. While this variety may be sown by broadcasting, as is common, to get highest yield, the crop must be thinned. This aspect is outside the scope of this article.

Transplanting method

Nursery raising requires about 200g seed, which contains about 80,000 seeds, to have enough for one hectare. The seed should be thinly sown @ 8 to 10 g/m². The nursery area should be heavily manured, same as in the case of raising cabbage/cauliflower seedlings. Mustard seedlings may be affected by damping-off disease. So Redomil/Captan should be sprayed as a preventive measure. Seedlings are ready for planting within 15-20 days.

It may not be possible to proceed according to schedule, of course. There might be so many unforeseen difficulties. To meet such eventualities, a second nursery may be raised following at a week's interval. Seedlings must be transplanted at a tender age, as with SRI, leaving a gap of 15-20 days before emergence of flowering stalks.

Seed Dressing: The seed should be soaked for 15 minutes in a 10% garlic solution, (10 gm crushed garlic in 100 ml water), then dried in the shade and sown in the seedbed. This has proved to be the better than use of conventional chemical fungicides.

Manuring and fertilization

Two to three tonnes of good-quality FYM/ha should be adequate. Mustard crop is a heavy feeder of boron and sulphur. Usually, 6 kg borax and 200-250 kg/ha of super phosphate would take care of the seeds' needs. Potash requirement is about 20-30 kg/ha. N may be applied @ 100-120 kg/ha. If Azotobacter is used as a biofertilizer, the N application should not exceed 100 kg N/Ha.

50% of the N and all other fertilizers, including borax, may be broadcasted along with FYM at the time of land preparation. Better still is to apply 50% N (urea coated with Nimin for slow release of N is recommended) with the full dose of P and K at the bottom of the furrow. The remaining 50% N is to be applied along with the irrigation at the time of first flowering.

Land preparation

We need not go into details of land preparation as this is fairly standard. The land is prepared by means of power-tiller/tractor/bullock-drawn implements. The soil need not

be pulverised. But after land preparation, a country plough and a pair of bullocks is very much needed to facilitate the layout of plants in a geometric pattern on the field.

After land preparation, the field is marked with straight lines 50 or 60 cm apart (depending upon fertility status, age of seedlings, and time of the season) by means of a country plough. Nylon threads may be used for the purpose to advantage. Two women workers would manage and guide the threads as in the case of line-transplanting in rice. Understanding the purpose leads to innovation and improvement of technique.

The fields are prepared according to ridge-and-furrow methods. The plough is run fairly deep while making the furrows. Then, inside the plough furrow, ripened manure (if inadequately broadcasted) and the recommended quantity of fertilizer mixture calculated to each meter-length of the furrow line is added by the workers. This is a kind of precision farming. Then a plank is run lightly along the furrow lines in order to partially cover the fertilizers, but still leaving a line of depression. When this is done, the plough is again run alternatively between the furrow spaces. This is called skip-furrow method. Finally, furrows are cut crosswise across the field at proper distances to form irrigation and drainage channels.

An interesting aspect of this cultivation method is the flexibility it gives for farmers in terms of schedule. This variety can be either broadcast or transplanted like paddy; its full potential can be achieved either way. Now, in Punjab and in some places in Haryana, varieties known as *Govi Sarson* and *Karan Rai* are being transplanted rather late, even in the month of December. Farmers transplant about 40-50 day-old seedlings after rice and harvest this crop in April. The duration of these varieties is 140-145 days, getting about 12-14 quintals of seed/ha. The winter season is prolonged there, which is an advantage.

Here in Orissa, *rai* (Indian mustard) needs to be sown during October to mid-November to get good yield. But most rice fields are not vacated by this time. So this time factor becomes a constraint. However, if the mustard crop can be transplanted late in the year, at a time that is unfavourable for sowing, the scope of cultivation for this crop is increased. This *Manikya* variety can be transplanted successfully up to the end of November; however, the earlier, the better.

Transplanting

Once the field is ready, the tender seedlings are uprooted with care, without injuring their roots. They may usefully be treated with bio-fertilizers. Then, water is let into the field from one end, and male/female workers begin to transplant just like rice seedlings, but only one plant per hill, following the fertilizer line at a distance of 30 or 35 or 40 cm from plant to plant, according to the soil situation. The roots should go straight down into the wet soil, having standing water in the furrow bottom (but not on the ridges), guided by two fingers to place the roots downward and then withdrawing the fingers.

Workers should use nylon threads to keep the line straight. This will facilitate mechanical weeding later on. In a well-prepared field, one person can plant about 1800 seedlings within 6 working hours. So 40-50 persons may be needed to transplant a one-hectare

field. When transplanting is completed, any excess water is let out through the drainage channels to dry out the field and to avoid water-logging. So proper layout is important. Gap-filling is not necessary. Plant density of 40,000 to 80,000/ha adapted according to different situations is enough. Average yield of 50-70 g/plant may be expected.

Irrigation

In total, three irrigations may be needed at critical stages, approximately at intervals of every 20-35 days -- at pre-flowering, at full bloom, and at pod-formation stages.

Pest attack

Earlier sowing or transplanting helps to minimize aphids and saw fly attack. Towards the end of January and afterwards, pest attack may be noticed. Then, suitable insecticides may be sprayed. But there is an alternative method. I no longer use the highly poisonous substances to control aphids and other pests as garlic-extract solutions do the job efficiently.

This is how the extract is prepared (ingredients/ha): garlic cloves (5 kg), kerosene (2 liters), and liquid detergent like Sandovit, Genteel, or Tee pal/APSA (100 ml). The garlic is crushed and grounded finely, preferably by means of a grinder with some water. Then it is pressed firmly to squeeze out all the garlic water. This water is stored in a bottle and kept tightly closed. Then, the crushed garlic is taken in a container, and kerosene is poured over it, just enough to cover it, and is kept covered overnight. Then, the kerosene oil is squeezed out. This kerosene oil contains the active volatile principles of garlic, which act against aphids, etc. This kerosene-garlic extract is made into a sprayable liquid by adding the required amount of liquid detergent to it. Before adding the detergent, however, the previous water extract solution is mixed with it. Generally 30-50 ml of detergent liquid is required per litre of kerosene oil. This stock solution is to be diluted by about 200-250 times for spraying. The spent garlic may also be broadcasted in the mustard field.

Disease reaction

Rust, downy mildew, nor alternaria blight have been noticed in several years of cultivation. So the crop might be resistant to those diseases. However, seed-dressing with 10% garlic extract solution is probably beneficial.

Weeding

Weeding at least once is very helpful. I use a hand-drawn wheel-hoe quite effectively. There is some merit in the soil-aerating properties of this kind of weeding.

Comparing methods of crop establishment

Transplanting the crop rather than broadcasting it may seem to be a costlier method of crop establishment. However, the labour requirement of sowing and then thinning the crop twice, to remove subsequently thousands and thousands of plants, may be more. When transplanting the crop, the plant population may be kept correct with mathematical precision, and there is also some time benefit. As explained earlier, by transplanting the full potentiality of individual plants can be realized.

Differences in cost of seed are roughly 200-400 g of seed/ha with transplanting vs. 6-10 kg of seed required for broadcasting. Two to four selected plants may be grown in a secluded place for seed purposes.

Harvesting

This must be done in a timely way to avoid shading of seeds.

Cost considerations

Total cost comes to about Rs.12,000/- per ha. With a yield of 20 Q/ha, and selling the produce @ Rs.2,200/Q, then the B:C ratio would be about 3.5:1, which is quite high.

Constraint

I have been using the same seed for the last 22 years as I have found no source of foundation seed. I collect seed from the ideal plants by pedigree selection. Still of late, I do not find the original vigour and productivity, so I am at a disadvantage.

There are many recently-released high-yielding varieties of mustard. They are all bred for high-density planting, however. Some varieties are of the desired plant types. But I have not tried them for fear of cross-pollination of my *Manikya* mustard variety.

Sreema Seeds Pvt. Ltd. of Cuttack and Nature Seeds of Balasore has been marketing this variety of mustard for the last 15 years or so. Sreema has published detailed instruction about cultivation, but I do not know how many have adopted the transplanting methods.

Chief Characteristics

Parentage: Local selection (Mayurbhanj)

Duration -- Broadcasted crop: 100-105 days maturity

Duration -- Transplanted crop: 85-90 days after transplanting

Height: 1 meter

Branching: Branching is profuse, about 7-10 from the main stem.

Silique length: 4-5 cm

Seed content: 12-15 seeds/silique.

100-seed weight: 2.13 gm

Seed yield (optimum): 25 Q/ha.

Harvest Index: 28.2

Oil content: not verified.

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