Intercropping Systems in Sugarcane

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Growing two or more crops simultaneously on the same field is known as intercropping/ companion cropping. Crop intensification is in both temporal and spatial dimensions. Until recent years, sugarcane crop was cultivated as a single crop. But rapidly increasing population, insufficient food, limited scope for extension of cultivation to new areas, diversified needs of small farmers for food and cash etc. have forced the adoption of intercropping systems.

Much of the space between two rows of sugarcane remains unutilized for an initial period of 100-120 days, because of slow growth. Companion cropping offers opportunity for profitable utilization of available space.

1. The crops suitable for companion cropping should have following characteristics:
2. The duration of intercrop should be less than 4 months to avoid contention with sugarcane.
3. Intercropping should not be competitive with the main crop in respect of sunlight, air, water and nutrients.
4. The growth habit of intercrop should be erect type and should have dissimilar root system.
5. The intercrop should not host insect and diseases which might affect sugarcane adversely.

Maximum cane yield, can be obtained when potato/ onion is grown as a companion crop with autumn planted sugarcane, followed by potato/wheat, toria/onion. The best crops identified with spring planted sugarcane were moongbean and urdbean. Moongbean, Sunflower or Soybean as an intercropping sugarcane field has been found to be profitable.

Suitable crop combinations

Most successfully adopted combinations are given as under -

- Sugarcane + Early potato (K. Chandramukhi)-Onion (Kalyanpur red).
- Sugarcane + Early Potato- Wheat (K 816).
- Sugarcane + Toria (T.9)-Onion.
- Sugarcane+ Early Potato/Vegetable Pea-Barley (Jyoti)

Planting mechanisms for potato and sugarcane

Potato Planter

Potato is an important crop in India. It requires a lot of labour for sowing seeds in fields. Potato planters are becoming very popular now days. Planting of potato starts by creating a open furrow, drop and space the seed pieces at various distances, place fertilizer to sides and below the level of seeds and cover the seed and put fertilizer to a desired depth. There are three main types of potato dropping mechanisms:

1. **Automatic Planters:** It consists of a hopper for each row and cups with chain drive mechanism. Graded potatoes are picked up by the cup and carried to furrow opener sprout and released in furrow. A feeder roller connected to compensating tray which contains spare potato checks for each cup. If a cup is empty a potato is released from compensating tray ensuring a uniform seed spacing with no missing. The fertilizer and pesticide can also be placed simultaneously. It can plant 2-4 rows. Its capacity may be 6000-14000 potatoes/hr.
2. **High Speed Automatic Planter:** It has two picker wheels, each having eight picker arms. Two picker wheels revolve only half as fast as a single picker wheel used at a normal speed. High speed planting is done at twice the normal speed but picker arms do not revolve faster than the single wheel.
3. **Semi-Automatic Planter:** It consists of hopper, metering disc and furrow openers. Fertilizer application unit can be attached separately. Potatoes, from hopper, are placed in metering disc which has compartments. The metering disc is rotated through gear drive mechanism. The potatoes drop due to gravity in furrow openers. Ridges are also formed by furrow

openers. It may plant 2 – 4 rows at the rate of field capacity of 0.15 – 0.25 ha/hr. It may be operated by a 20 – 25 hp tractor.

Sugarcane Planter

It is used for planting sugarcane sets. Desired spacing between row to row and plant to plant is maintained for sugarcane planting. The fertilizer and chemical pesticides can be applied simultaneously. The machine consists of a hopper, two rotating distributor discs, two fertilizer hoppers, pesticide tank with a distribution value and two furrow openers. All these components are mounted on a frame and two wheels. Seed distributor box and applicator are powered from ground wheel through a set of roller chains and gears. Two persons are required to put sets in seed rotor manually from hopper. Machine is mounted on a tractor. Output may be 0.6 ha/h and it requires 4-6 men for field operations.

Objectives of Planting

1. To establish an optimum plant population and plant spacing to obtain the maximum net return per hectare.
2. Population and spacing requirements are influenced by
3. Kind of crop
4. Type of soil
5. Fertility level of soil
6. Amount of moisture available
7. Effect of plant and row spacing upon cost and convenience of operations such as thinning, weed control, cultivation and harvesting.
8. Principal requirement from yield point is to keep the number of plants per hectare more as with many crops. There is fairly narrow range of plant population that will give maximum yield under a particular combination of soil and the fertility conditions. So as the optimum number of plants per hectare is increased and the productivity of soil also increases. But for other crops like cotton and small grains there is a wide range of plant population over which yields do not vary appreciably.

Factors affecting Germination and Emergence

1. Factors affecting seed emergence rate are influenced by:
2. Viability of seed (percentage germination under controlled laboratory conditions)
3. Soil temperature
4. Availability of soil moisture to seeds
5. Soil aeration
6. Mechanical impedance of seedling emergence (resistance of soil to penetration by seedling)

These are influenced by:

1. Soil type
2. Physical condition of the soil
3. Depth of planting
4. Intimacy of contact between seeds and soil
5. Degree of compacting of soil above the seeds
6. Formation of surface crusts after planting
7. Final field stand is also due to disease, insects, and adverse environmental conditions.

Field emergence rate of 80% to 90% are typical for corn and other crops that tolerate a fairly wide range of planting conditions. Field emergence with sugar-beets and many small seed vegetable crops is so low and unpredictable i.e. 35% to 50%.

Functions of Seed Planter

Seed planter is required to perform following mechanical functions

1. Open seed furrow to proper depth
2. Meter the seed
3. Deposit the seed in the furrow in an acceptable pattern
4. Cover the seed and compact soil around seed to the proper degree for type of crop involved
5. Planter should not damage the seed enough to appreciably affect the germination
6. Seed should be placed in the soil in such a manner that all the factors affecting germination and emergence will be as favorable as possible.

Effect of Planter or Planting System upon Emergence Factors

1. Good planter performance is essential for obtaining an adequate stand with crops whose emergence is critical.
2. Precise depth control, placement of seeds into moist soil and non-crusting conditions above the seeds are important for small seed vegetables and some other crops.
3. Packing of soil by planter can affect the availability of moisture, availability of oxygen and mechanical impedance.

Devices for Metering Single Seeds

Devices having cells on a moving member (cells sized to accommodate one seed or group of seeds) e.g. Horizontal plate planter.

1. **Horizontal plate planter** has a spring-loaded cut-off device that rides on top of the plate and wipes off excess seeds as the cell moves beneath it. A spring-loaded knock-out device pushes the seeds from the cells when they are over the seed tube.
2. **Plates with round or oval holes** are used for drilling or hill dropping of various row crops.
3. **Edge-cell**, edge-drop plates are used for planting relatively large, flat seeds.
4. **Inclined plate metering devices** have cups or cells around the periphery that pass through a seed reservoir fed under a baffle from the hopper, lift the seeds to top of plate travel and drop them into delivery tube. A stationary brush is provided for more positive unloading. Seeds are handled more gently than with horizontal plate unit because there is no cut-off device. The metering unit has an edge-cell plate with sizes available to fit various kinds of small vegetable seeds. Plate and surrounding ring are accurately machined to provide uniform cell sizes for precision metering.
5. **Vertical-rotor metering devices** are used for precision planting of vegetables and sugar-beets. In some units seed tube is omitted and rotor placed as low as possible and discharge seeds directly into the furrow. These units also have seed cups which move up through a shallow seed reservoir, pick-up single seed, carry them over the top of the circle and discharge them during the downward travel.
6. **Cells in a Belt** is also another type of precision metering device in which seeds are fit to size. Seeds from hopper enter the chamber above the belt through opening and are maintained at a controlled level. As belt moves clockwise, counter-rotating seed repeller pushes back excess seeds so there is only one in each cell. Seeds in cells are conveyed over the base and discharged from belt beneath the seed repeller wheel. Lack of positive unloading device causes some variability in seed spacing.
7. **Single seed metering devices** that do not have cells are used for all type of seeds. In these twelve spring-loaded cams operated fingers on radial arms rotate, gripping one or more seeds as they pass through the seed reservoir. One seed is released as each finger passes over to small indents near top of stationary disk. As finger continues to rotate it throws the remaining kernels into one of 12 cells in the adjacent, rotating seed wheel and seed wheel discharge the individual kernels into furrows.
8. **Pneumatic (air-pressure) Metering System** has a centralized hopper and metering unit that serves 4, 6 or 8 rows. The ground driven seed drum has one circumferential row of perforated seed pockets for each planter row. A shallow reservoir of seed is automatically maintained in the drum by gravity flow from the hopper. A PTO driven fan supplies air to the drum, maintaining a pressure of about 4 kPa (0.6 psi) in the drum and in the hopper. Air escapes through holes in the seed pockets until a seed enters the pocket. Differential pressure holds the seeds, the revolving drum carries a stationary brush near the top that knocks off any excess seeds. Air-cutoff wheels on top of drum momentarily block the holes, causing seed to drop into seed-tube manifold. Air flow through the tube

carries the seeds to the planting units and deposits them in the furrows. This is generally used for crops such as corn, beans, grain sorghum.

- Pneumatic principle is also used for single row metering devices for unit planters. Small blowers driven by electric motors connected to the tractor's electrical system provide air-pressure in metering chamber. Seeds are held against the holes in the rotor. Seed pockets are carried upward and around in a counter-clockwise direction in the unit. The seeds are released into seed tube when pockets pass a baffle that cutoff the inner air pressure to the front (left hand) portion of the rotor. Different disc rotors are used for different kinds of seeds.

9. **Vacuum Pick-Up Devices** are also available for seed metering. In this there is a central vacuum pump with valves to each pick-up orifice, seal between stationary piping and rotating pick-up assembly. A stationary cam extends the piston to produce pressure for unloading the seeds and a spring retracts it to develop the vacuum for seed pick-up. Vacuum pick-up devices can perform effectively with small, irregular shaped seeds like lettuce. These are sensitive to dust and dirt.

- The average spacing of seed and hill is determined by ratio of linear or peripheral speed of seed pick-up units (cells, fingers etc) to the forward speed of planter and by the distance between seed pick-up units on the metering unit. Changing the speed ratio is the most common method of changing seed spacing.

10. **Seed Tape Planting System** is the precision planting system. Seeds are deposited either singly or in groups (hills) on a water soluble table in a laboratory under controlled conditions. Equipment is available for single out and spacing small, irregular shaped seeds on tape with high degree of accuracy. The seeds are placed on the tape at the desired field spacing and a continuous strip of tape is un-released and placed beneath the soil by a simple planting unit. The tape is a polyethylene oxide that is stable under normal atmosphere conditions but dissolves in one or two minutes when placed in most soil. It is used for planting lettuce, tomatoes, cucumbers and some other vegetable crops. The tape is expensive and good soil preparation is imperative. A large amount of tape per hectare is needed especially for close spaced rows i.e.20 km/ha for 51 cm row spacing Precise depth control is difficult to maintain but planting can be done at relatively high forward speed. Seed spacing in the row is pre-determined when seed tape is made and is precise in the field. Increased yields are reported with this for lettuce and cucumbers. A special planter that cuts the tape into single seed sections and deposits these sections in cone-shaped pockets are pressed into the soil. An arrangement is provided to meter a charge of non-crusting soil amendment (vermiculite) into each pocket to cover the tape. Perforations along one side of seed tape synchronized the depositing of seeds on tape and cutting the tape into sections by planter.

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