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Seed Pelleting and its Effect on Seed Quality of Crop-A Review

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Abstract

Seed is a basic input of agriculture and inferior quality seed give poor performance as well as yield. Production of small seed size crop is difficult, time consuming and costly, due to challenging in mechanized planting, proper seed handling and improper distribution of seed in the field. Seed pelleting is the process of adding inert materials to seeds to change their size and shape for improved plantability. Small and irregularly shaped seed can be treated as large, round-shaped, that simplifies planting seed in the filed as well as in the precise location. Pelleting is also seed management techniques in which growth promoter, different pesticides and extra nutrition are applied on the seed to enhance seed quality. The paper, therefore, aims to reviewing the seed pelleting and its effect on small seed crop. Mainly two types of component are used in seed pelleting such as, bulking (coating) and binder. The bulking (coating) change the size, shape and weight of seed, whereas the binder holds the coating material together. Seed pelleting machine has different parts that includes feeding units, pelleting chamber, power source and drive system, main frame and dry machine. Seed pelleting makes small and irregular shaped seeds into bold, round with smooth surface that is easy for handling during planting. Pelleting is also used to decrease the seed rate for small size crop and to reduce the cost of crop production. Pelleting of seed by different pelleting material is important for improving seed quality.

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Pelleting size, Pelleting Material, Seed Quality, Seed Size, Pelleting Machine.

Introduction

Seed is a basic input of agriculture. Inferior quality seed give poor performance and yield potential is too low and it production cost occurred very high. In some crops such as onion, lettuce and carrot have small seeds that are difficult to handle during sowing and seed rate became higher. All of these make seed production cost high. So, it is necessary to improve the quality of seed by using seed enhancement technique (Jyoti and Bhandari, 2016).

The small seed size crop like sesame production cost increased considerably, because of small size of the seeds, and difficulty in mechanized planting, hence broadcast seeding is common worldwide. Lack of mechanization for cultural practices led to the use of broadcast seeding. In broadcast seeding method, seed rate is not well adjusted. This negatively affects the yield and increase cost of production. Therefore, increasing the yield and expanding the use of mechanization for planting is necessary. In sowing plants with seed drill, one of the major factors in obtaining high yield is the sound cultural practice. As it is known, the biggest obstacle in planting sesame by seed drill is the fact that the seeds are too small. With the help of seed pelleting, it will be possible to enlarge the diameters of the seeds and

plant them with a pneumatic spacing planter (Dogan and Zeybek, 2009).

Seed pelleting is the process of adding inert materials to seeds to change their size and shape for improved plantability. Small and irregularly shaped seeds, such as lettuce seeds, can be treated as larger, round-shaped seed thanks to pelleting. Pelleting simplifies singulating seeds in the field and planting them in precise locations.

For crops like onion, precise seed placement is of great advantage as uniform bulb development is assured with equal distance planting. It is the process of enclosing a seed with small quantity of inert material just large enough to produce a globular unit to facilitate precision planting. The inert material creates natural water-holding media and provides small amount of nutrient to young seedlings (Roos, 1979; Scott, 1989; Krishnasamy, 2003)

Pelleting is a pre-sowing physical seed management technique, in which growth promoter substances or any needy substance with protective, nutritive and invigorative function are applied on the seed to enhance the seed-soil interface (Scott, 1989)at the rhizosphere region. Some of the common benefits of pelleting are uniformity in size, easier planting, uniform stands, reduced seed rate, more resistance to insect and disease, stress tolerance and nourishment to the seedlings (Balaji, 1990; Angamuthu, 1991; Nargis, 1995)

Pelleted seed helps in the mechanization of seed sowing in the field as well as in the nursery. In addition, bio-fertilizers, bioactive chemicals, seed protectants etc. can be incorporated effectively into the pelleting that will be useful for ensuring better field emergence and crop establishment under sub-optimal conditions.

Seed pelleting helps in supply of extra nutrients and provide an establishment of proper stand of crop (Wyk, 1983). The paper, therefore, aims to reviewing the seed pelleting and its effect on seed quality of small seed crop

Seed Pelleting Material and Its Component

The materials used for seed pelleting should be perfect as the type of adhesive decides the physical integrity of pelleting and this is highly influenced during handling, transport and planting operations of the pellets. There are different material used in seed pelleting like, gypsum, clay, cow dung, vermicompost, clay, red soil, sand, talc powders and leaf powders of neem, and Pongamia as filler materials and methylcellulose, polyvinyl alcohol, gelatin, rice gruel, guar gum, gum arabic as adhesives alone or in combination for their suitability as pelleting and coating materials in various concentrations (Yogeesha *et al.,* 2017)

There are two components to a seed pellet: bulking (coating) material and binder. The bulking material can be either being a mixture of several different mineral and/or organic substances or a single component. The coating material is the "work-horse" of the pelleting material.

The coating material changes the size, shape and weight of the seed. Desirable characteristics of a good coating material include: uniformity of particle size distribution, availability of material, and lack of phytotoxicity, usually delivered in powder form that are responsible for the increase in weight and size (Pedrini *et al.,* 2018).

The second component, the binder, holds the coating material together. Binder concentration is critical because too much binder will delay germination. Too little binder will cause chipping and cracking of pellets in the planter box, which can cause skips and/or wide gaps in the plant rows. Many different compounds have been used as binders, including various starches, sugars, gum Arabic, clay, cellulose, vinyl polymers (Halmer, 2006) and even water (Burgesse, 1949).

The binders that are commonly used to inoculate vegetable seeds usually originate from polymers and, therefore, have a high molecular weight; included among these are Gum Arabic, methylcellulose, polyvinylpyrrolidone (PVP) and polyvinyl acetate (PVA). PVP is appropriate for coating seeds that will be submitted to impact and abrasion during sowing or those, which will be mixed with fertilizers.

Seed Pelleting Machine

The feeding unit (hopper), pelleting chamber (die-plate and press-roller encased in cylindrical chamber), pellet discharging and power transmission unit with accompanying frame combined together forms a rotating die and roller type portable pelleting machine (Shrinivasa *et al.,* 2021).

Feeding unit

Feeding unit was designed to feed the mixture to the pelleting chamber. The feeding unit consists of inverted truncated cone, gravity flow type hopper.

Pelleting chamber

The pelleting chamber is the hollow cylinder which houses the die plate, press-rollers, clearance adjustment mechanism (between die plate-roller), pellet cutting knife, perforated pellet separator plate & pelleted and un-pelleted feed outlets. The die plate is considered as the heart of the pelleting machine. The die plate selection is a function of quality & production rate and die speed (rpm) is a function of the feeds to be pelleted (Kaankuka and Osu, 2013).

Power source and drive system

The power required by the pelletizer for pelleting mainly comes from the extruding deformation area and the extruding formation area (Kai *et al.,* 2010). The selection of motor for power supply to the pelleting machine depends on the choice of capacity, motor type, voltage and speed (Ji-qiu *et al.,* 2010).

Main frame

The main frame, which provides rigid support and space for the electric motor and pelleting unit, was fabricated by using square MS (mild steel) pipe. The width, length and height of main frame for pelleting machine were based on the geometry of pelleting chamber and motor.

Effect of Seed Pelleting on Seed Quality

An important property of pelleted seeds is mechanical integrity. A pellet should have sufficient structural integrity to survive drying, packaging, distribution, storage and deployment, without breaking or crumbling (Hill, 1999). Mechanical integrity and the ability to retain active ingredients onto the seed is paramount importance (Nuyttens *et al.,* 2013), especially when pellets are loaded with compounds, such as pesticide, that can be harmful to the human operators and the environment.

In recent years, various strategies have been employed to improve abiotic stress tolerance during seed germination. Seed pelleting is an effective, practical and facile technique to enhance rapid and uniform emergence, high seedling vigor, and better yields in many field crops particularly under unfavourable environmental conditions (Powel and Matthews, 1988). Recently, Rocha *et al.,* (2019) reported that coating cowpea seeds with *P. putida* using silicon dioxide and starch significantly increased biomass and seed yield under water deficit. Pelleting of rice seeds with clay or diatomaceous clay increased germination percentage by 43 and 26%, respectively, compared with naked seeds. Some research indicated pelleted tobacco seeds using the combined materials with a superabsorbent polymer, poly hydrogel, and salicylic acid (SA) enhanced drought-tolerance and significantly improved seed germination, as well as seedling growth (Guan *et al.,* 2014).

Pelleting is applied for a variety of reasons: improve physical properties of the seed for ease of handling, reduce use of pesticide dust on seeds, better protection against diseases, and direct application of nutrients and growth regulators to increase seedling growth (Bennett *et al.*, 1992). In the case of direct sowing precision sowing is difficult if seeds are too small and irregular in shape. Seed pelleting makes small and irregular shaped seeds into bold, round with smooth surface that helps in separation of seeds individually and easy handling of seeds during sowing. In crops like onion (*Allium cepa* L.) and carrot, the seed rate can considerably be reduced and thinning and gap-filling operations can be eliminated by use of pelleted seed provided the seed is of high quality. For crops like onion, precise seed placement is of great advantage as uniform bulb development is assured with equal distance planting (Hill, 1999).

Pelleting, which is the technique for coating seeds, is a potential alternative for improving sowing efficiency, since it allows the seeds not only to gain both weight and volume but also standardizes seed size in terms of length, width and thickness. Furthermore, the pellet's external surface is smooth and not deformed, facilitating its planting by seed drills.

Pelleting improves the chances of successful germination and seedling establishment under field condition (Bharathi *et al.,* 2003) and protect the seed borne fungal and insect attack finally contributing to increased seed yield (Taylor and Eckenrode, 1993). However, performance of pelleted seeds is influenced by several factors like, seed coating material, soil and aerial environment and further physical, chemical and biological components.

The performance of resultant seeds in terms of germination, speed of germination, seedling growth, dry matter production, vigour index, electrical conductivity of seed leachate, dehydrogenase enzyme activity and oil content were in favour of the cotton seeds given pelleting treatment with arappu leaf powder + DAP + micronutrient mixture (Rathinavel *et al.,* 2000). Some

research activities indicated that pelletized rice seeds with clay or diatomaceous clay increased germination percentage by 43 and 26%, respectively, compared with naked seeds (Peiyu *et al.*, 2004)

They way forward

By pelleting the small seed size crops, using different pelleting material is important in decreasing seed rate, proper seed distribution and uniform emergency of seedling. Supplement of pelleting material with growth promoter, pesticides and nutrition can improve seed quality. So seed pelleting is important in modern agriculture that need attention for small seed size crop to reduce cost of production and challenge during seed planting

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