EMERGENCE RESPONSE OF SUNFLOWER CULTIVARS (*Helianthus annuus* L.) TO PLANTING TECHNIQUES AND SOIL FACTORS

by

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ABSTRACT

South Africa mainly produces oil seed sunflowers of which 86% is produced in the Free State and North West provinces which are known for their sandy soils. Temperatures can rise to 42°C in these soils when planting commences during November to January. These conditions, in combination with other factors such as planting date and planting depth, soil type, different cultivars, and seedling vigour, can influence the emergence rate of sunflower seedlings. This will cause uneven stand which could affect the yield negatively.

In an attempt to evaluate the influence of soil factors and planting techniques on sunflower emergence, three experiments were conducted in the greenhouse at the Department of Soil, Crop and Climate Sciences of the University of the Free State. These experiments evaluated the effect of seed size, planting techniques, and soil factors, and high soil temperatures on the emergence rate of selected sunflower cultivars.

Three seed sizes (seed size one to three) of three cultivars (PAN 7049, PAN 7057, and PAN 7063) were planted at two planting depths (25 and 50 mm respectively) during three planting dates (September 2010, November 2010, and February 2011) to determine the influence on the emergence rate of seedlings. It was found that a smaller seed size, such as seed size three, emerged faster than larger seeds, seed size one.

The influence of two planting depths (25 and 50 mm) during the previously mentioned planting dates with two soil types (Bainsvlei and Tukulu) on the emergence of sunflower seedlings was also tested. Cultivar emergence was faster at 25 than at 50 mm. It was also observed that the emergence rate was faster during February 2011 than during September and November 2010. Although the emergence was faster during February 2011, above ground growth (plant height and dry weight) was greater during November 2010 than during September 2010 and February 2011.

The influence of four soil temperatures (35, 40, 45, and 50°C respectively) on the emergence of sunflower cultivars was tested. An under floor heating wire (23 kW) was attached to a galvanised metal grid and was used to simulate day and night temperatures in the top soil. The grid and seed were placed at a depth of 25 mm (planting depth). Emergence index declined gradually from 35 to 45°C, but a rapid decline in emergence index was observed from 45 to 50°C.

Emergence can be measured or calculated as an emergence index. Emergence is determined as the moment that the seedling is visible above the ground and different formulas exist to determine the emergence. Experiments differ from one another and therefore different emergence index models were developed to accommodate the experiment methods or crop that was used. It can therefore be concluded that differences in emergence exist between cultivars. It is also necessary for producers to acknowledge that soil factors and planting techniques play a vital role during planting until the seedling emerge.

Keywords: Sunflower emergence, soil temperature, seedling growth, seed size, planting depth, planting date

OPSOMMING

Produksie van sonneblomme in Suid-Afrika is meestal vir olie. Ongeveer 86% word in die Vrystaat en Noord-Wes provinsies, wat ook vir sanderige grond bekend staan, geproduseer. In dié grond kan temperature van November tot Januarie bo 42°C tydens die plantseisoen styg. Hierdie toestande, in kombinasie met ander faktore soos plantdatum, -tyd, grondtipe, kultivarverskille en saailing groeikragtigheid, kan die opkomstempo van sonneblomsaailinge beïnvloed. Dit kan lei tot oneweredige plantestand wat opbrengs nadelig kan beïnvloed.

Ten einde die invloed van grondfaktore en planttegnieke op die opkoms van sonneblomme te evalueer, is drie eksperimente in die glashuise van Departement Grond, Gewas en Klimaatwetenskappe van die Universiteit van die Vrystaat uitgevoer. Hierdie eksperimente het die invloed van saadgrootte, planttegnieke en grondfaktore, asook hoë grondtemperature op die opkomstempo van geselekteerde sonneblomkultivars getoets.

Drie saadgroottes (saadgrootte een tot drie) van drie kultivars (PAN 7049, PAN 7057 en PAN 7063) is op twee plantdieptes (25 en 50 mm) geplant op drie plantdatums (September 2010, November 2010 en Februarie 2011) om die invloed op die opkomstempo van saailinge te bepaal. Daar is gevind dat kleiner saadgroottes soos saadgrootte drie vinniger ontkiem as groter sade (saadgrootte een).

Die invloed van twee plantdieptes (25 en 50 mm) by die drie plantdatums op twee grondtipes (Bainsvlei en Tukulu) op die opkoms van sonneblomsaailinge is ook bepaal. Kultivaropkoms was vinniger by ‘n plantdiepte van 25 as by 50 mm. Opkomstempo was ook vinniger gedurende Februarie 2011 as gedurende September en November 2010. Alhoewel die opkomstempo tydens Februarie 2011 vinniger was, was die bogrondse groei van plante (planthoogte en droë massa) egter beter gedurende November 2010 as die ander plantdatums.

Laastens is die invloed van vier grondtemperature (35, 40, 45, en 50°C) op die opkoms van sonneblomkultivars bepaal. ‘n Ondergrondse verhittingsdraad (23 kW) is aan ‘n gegalvaniseerde metaalrooster geheg. Die verhittingseenheid is gebruik om dag- en nagtemperature in die bogrond te simuleer. Die rooster en saad is op ‘n diepte van 25 mm (plantdiepte) geplaas. Opkoms-indeks het geleidelik afgeneem vanaf 35 tot 45°C, maar ‘n drastiese afname was sigbaar in die opkoms-indeks vanaf 45 to 50°C.

Opkoms kan gemeet of berereken word as ‘n opkoms-indeks. Opkoms word bepaal wanneer die saailing sigbaar is bokant die grond. Verskillende formules bestaan om hierdie opkoms te bepaal. Eksperimente verskil en daarom is verskillende opkoms-indeks modelle ontwikkel om ‘n eksperimentele metode of gewas te akkomodeer. Uit hierdie eksperimente is dit duidelik dat opkomsverskille tussen kultivars bestaan. Grondtemperature kan opkoms beïnvloed en meer navorsing is noodsaaklik in Suid-Afrika waar hoë grondtemperature algemeen voorkom tydens die plantseisoen. Produsente moet ook kennis neem dat grondfaktore en planttegnieke ‘n belangrike rol speel vanaf plant tot opkoms.

Kernwoorde: Sonneblomopkoms, grondtemperature, saailinggroei, saadgrootte, plantdiepte, plantdatum