RESEARCH PAPER | International Journal of Agricultural Engineering | Volume 5 | Issue 2 | October, 2012 | 225 –228

Sensor for seedling spacing and flow measurement in vegetable transplanter

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Received : 25.06.2012; Revised : 20.08.2012; Accepted : 22.09.2012

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ABSTRACT : An opto-electric sensor was developed for measuring seedling spacing and seedling flow through seedling delivery tube. It was evaluated both in soil bin and field conditions. Seedling spacing was determined from signals obtained by sensor in soil bin and field conditions by data acquisition system and oscilloscope, respectively. At 45 cm seedling spacing, variation in seedling spacing measured manually and by sensor at 0.6 to 2.2 km/h speeds for tomato, brinjal and chilli in soil bin were analyzed for all type of seedlings used and for entire range of speed varied from 1 to 2.16 cm and 0.99 to 1.62 cm for tomato, 0.06 to 0.92 cm and 1.08 to 2.2 cm for brinjal, 0.98 to 1.89 cm and 0.45to 1.32 cm for chilli, respectively where as in field conditions it varied from 1 to 2.16 cm and 0.99 to 1.62 cm for tomato, 0.06 to 0.92 cm and 1.08 to 2.2 cm for brinjal, 0.98 to 1.89 cm and 0.45 to1.32 cm for chilli, respectively.

KEY WORDS : Optoelectric sensor, Seedling spacing, Seedling flow, Vegetable transplanter

HOW TO CITE THIS PAPER : Nandede, B.M., Kumar, Ranjeet and Padhee, D. (2012). Sensor for seedling spacing and flow measurement in vegetable transplanter. *Internat. J. Agric. Engg.*, **5**(2) : 225-228.

After raising good quality seedlings, transplanting them in the field with uniform spacing is one of the stages in the production of many vegetable crops (Singh, 2008). It is carried out by vegetable transplanters using various type of metering mechanisms (Shaw, 1997). Uniform spacing between plants provides enough space for the plant to grow and develop and reduce the nutrient uptake competition between plant and weeds by depressing the weed growth (Heege, 1993). Hence, evaluation of metering mechanism is, therefore, essential as it is required for maintaining the recommended plant spacing and population. The conventional method for seedling spacing measurement in the field is manual and is a very tedious process. Most of the studies on seed spacing evaluation were made either with a sticky belt test stand or an optoelectronic sensor (Raheman and Singh 2003; Panning *et al.*, 2000; Kocher *et al.*, 1998) high-speed camera system used of wheat and soybean seeds (Karayel *et al.*, 2006). From all the tests he found that the high-speed camera system did not miss any seed but costlier attempt for paper pot seedling spacing detection. Hence, opto-electric sensor was developed for proper detection of seedling flow. In automatic vegetable transplanters, the seedlings are fed to the metering mechanism and transplanted in the field without human intervention. It is very difficult for the tractor operator to see the workability of the metering unit while working in the field. Therefore, an attempt was made to develop a sensor which could show the flow of seedlings.

METHODOLOGY

Development of light sensor and working principle:

The developed sensor comprised a power supply unit, transformer, rectifier diodes, regulator IC, capacitors, light source, optical sensor, comparator and LED. Detailed drawing with component designation is shown in Fig. A. Two options both 12 V battery and 220 V AC supply were kept to supply the power to the opto-electric sensor circuit so that in the laboratory it could be operated by 220 V AC supply. Working principle of a sensor is based on light. When the power was supplied to the circuit the transformer circuit could step-down the 220 V to 12 V AC supply. The rectifier circuit consisting of diodes was used for converting the AC supply to 12 V DC supply. One connection of 12 V DC was then sent to the regulator IC which reduced the 12 volt DC to 5V DC and sent to the light source. Another connection for supplying 12 V was given to the comparator from where the connection was made with light sensor. After comparator the output was measured through (J3) and the LED was placed in the circuit. When the power was supplied through either 12 V battery or 220 V AC supply, the light source emitted the light which was sensed by the optical light sensor. When the pot seedling in seedling delivery tube obstructed the light path, fluctuation of voltage occurred which were recorded by DAS over time