DESIGN AND DEVELOPMENT OF ARDUINO BASED SEED SOWING MACHINE

ABSTRACT:-

Pulses is one of the important crops. The food value of pulses is essential due to its high protein content. The pulses crop is mainly grown for its grains which are consumed either whole or in split form (dal). Properly and timely sowing has a dominant effect on germination of seed, plant growth, plant population in the field and ultimately on the total production. In general, pulses is sown by animal/tractor drawn seed drill or manually. Tractor drawn seed drills are suitable for medium or big farms with high seed rate. Draft animals are not only becoming costly but they are diminishing also. More than 75 % of Indian farmers belong to small and marginal category and doing all operations manually. Manual sowing is a highly labour intensive, tedious, time consuming and not technically suitable. Therefore, a double row ardiuno based battery operated seed sowing machine for pulses seed was developed and tested.

During the study, the required physical property of chickpea seed was determined. The developed seed drill was tested for laboratory and field test. The overall size of developed seed sowing machine was 930×600×740 mm. It was operated by24V, battery. A DC motor of 250 watt 24V was used as power source. Ground wheels have 15 lugs. It sowed seeds in two rows at a time. The overall weight of developed seed drill was 37 kg. In the laboratory test, seed rate, and mechanical damage of the developed seed sowing machine were found as 63.20 kg/ha ,and 1.20% respectively. The overall performance of the developed seed sowing machine was found satisfactory.

While in the field, draft of implement 37.19 kgf, missing index 2.46%, depth of seed placement 6.10cm ,and draft of implement 14.51 kgf ,missing index 3.63% ,depth of seed placement 6.20 cm, The field efficiency of the developed seed sowing machine 83% respectively.

Keywords – Chickpea, sowing method ,seed drill

1. INTRODUCTION:-

Agricultural mechanization entails the use of various power sources as well as improved farm tools and equipment in order to reduce the drudgery of humans and draught animals, improve cropping intensity, precision, and timeliness of utilization of various crop inputs, and reduce losses at various stages of crop production. The ultimate goal of farm mechanization is to increase overall productivity and production while lowering production costs.

Sowing is one of the most critical aspects of crop production. Timely planting has a significant impact on seed germination, plant growth, plant population in the field, and, eventually, total yield. The capacity of any sort of sowing equipment to deposit the seed at the right distance, depth, and clusters with low draft and improved coverage is critical. Experiments have demonstrated that using improved agricultural implements, such as planting machinery, not only increases output but also reduces manual labor and improves man-machine compatibility..

One of the most significant operations is seed sowing, which incorporates aspects such as correct seed rate, optimum depth of seed placement, and sufficient seed spacing. Several studies on crops that require a fixed distance between plants show that using country seed drills requires a skilled person to accurately meter the seed. If a skilled person is not available, plant population may not be up to level, resulting in a 10 to 20% higher seed rate and thinning is required to get desired plant population**.(Kalkat*et al*.,1997).**

For the foreseeable future, a developing country like India is projected to rely more on hand tools for cultivation. Hand tools are still used for land cultivation in India since draft animals and tractors demand resources that many Indian farmers do not have easy access to. The importance of agricultural mechanization in operations and the value agricultural power generates for them.

More than 75% of farmers are classified as marginal or tiny, and their economic situation is also poor. Normally, farmers scatter the seed by hand, walking along the row, which is time consuming, tiresome, expensive, and non-technical. During Rabi 2017-18, the area under chickpea was 10.76 million hectares, with a production of 11.16 million tonnes and a productivity of 1037 kg/ha. During 2017-18, the area under chickpea was 0.293 million hectares, with a total production of 0.367 million tonnes and a productivity of 1253 kg/ha. The top expanding states are Madhya Pradesh, Uttar Pradesh, Rajasthan, Maharashtra, Gujarat, Andhra Pradesh, and Karnataka (Annon., 2018). However, despite being the world's greatest producer of chickpeas, India is unable to meet its own demand.

Chickpea seeds contain essential amino acids like isoleucine, leucine, lysine, phenylalanine and valine **(Karim and Mirza, 2007).** Like other pulses, supplementation of chickpea with cereal based diets is one of the possible options to mitigate the problems associated with protein energy malnutrition.

2. MATERIALS AND METHODS:-

2.1 Experimental details

In order to evaluate the performance of a seed sowing machine, it is essential to test it with respect to seed rate, missing index, depth of placement, field efficiency and cost of operation. The dependent and independent parameters which studied are given in the following Table 1.

Table 1 : Performance evaluation of the machine

Sno.	Variables	Parameters	Levels
1	Independent Parameters	Hopper fill, H	H1 = Full fill
			H2 = ¾ Fill
			H3 = ½ Fill
			Ground
		Ground wheel rpm	N1 =30
			N2 =40
			N3 =50
2	Dependent Parameters	Seed rate Missing index	
		Depth of placement	
		Field efficiency Draft of implement	

2.2Constructional details of various components of the developed seed sowing machine

In designing and development of the battery operated two row seed sowing machine, the basic emphasis was given on simplicity of fabrication, use of locally available material and low cost of construction. Ease of assembling and dismantling for repairs and inspection were also considered. The developed seed sowing machine consisted of main frame, seed hopper, DC motor, Battery, metering mechanism, sprockets, chain, furrow opener, ground wheel, Furrow wheel, handle, The Arduino UnoR3, Dc motor controller**,** L298NDriver and Ir sensor.

Table 2: Detail specifications of the developed seed sowing machine

Sr. No.	Particulars	Specifications
	Name of the equipment	Battery operated two row seed drill

Overall dimensions	Length	930 mm
	Width	600mm
	Height	790 mm
	Weight	35kg
Seed hopper	Material of construction	Steel
	Upper portion of hopper	370mm
	Lower portion of hopper	130mm
	Angle of repose	350
	Volume	0.002 m^3
	Capacity	12kg
Feed hopper	Material of construction	Steel
	Rectangular box	130mm
	Depth	170 mm
Rotor	Material of construction	Plastic
	Diameter	100 mm
	No. of cell	10
	Length of cell	25 mm
	Depth of cell	6 mm
	Diameter of cell	6 mm
DC motor	Power	250 watt
	Rpm	Variable
	Current	16 Amp
	Input volt	24 Volt
Wheel shaft	Material of construction	Round bright bar
	Length	600 mm
	Diameter	15 mm
Wheels	Material of construction	Cast iron
	No. of wheels	4
	Diameter	350 mm
	No. of spokes	5

3. RESULTSANDDISCUSSION:-

3.1 Performance Evaluation of seed sowing machine

Mean value of seed rate for different ground wheel rpm against hopper filling are evident from the observation that for all different ground wheel rpm the full hopper filling achieved the highest seed rate, followed by the 3/4 hopper filling and ½ hopper filling.

Mean value of mechanical damage for different forward speed against hopper filling observation that for all different forward speed the full hopper filling achieved the highest mechanical damage, followed by the 3/4 hopperfillingand1/2hopperfilling.

Table 3: Mean values of seed rate at different level of hopper filling

Test	Hopper filling		
	Full	¾	½
Mean seed rate, kg/ha	64.7	64.2	60.9
Mean mechanical damage, %	1.65	1.53	0.72

3.2 Effect of revolution of ground wheel on seed rate

The mean values of Seed rate and mechanical damages of three different level of forward speed were compared and are given in Table. It shows that the mean values of mechanical damage for all three levels were significant. It also shows that on 50 rpm forward speed, mechanical damage was highest.

The mean values of mechanical damage are three different forward speeds for all three-different level of hopper filling. From figure it is observed that for all hopper filling, the mechanical damage was highest in case of 50 rpm forward speed.

Table 4: Mean values of seed rate at different level of hopper filling

Test	Ground wheel, rpm		
	30	**40**	**50**
Mean seed rate, kg/ha	62.14	63.15	64.59
Mean mechanical damage, %	0.94	1.2	1.76

3.3 Field test of mean values of missing index (%), Mean number of multiples (%), Mean depth of placement(cm) and Mean field efficiency (%) at different level of hopper filling

Missing index (%), Mean number of multiples (%), Mean depth of placement (cm) and Mean field efficiency (%) for different forward speed against hopper filling. This is evidentfrom the observation that for all different Forward speed the full hopper filling achieved the highest missing index (%), Mean number of multiples (%), Mean depth of placement (cm) and Mean field efficiency (%),followed bythe3/4 hopper filling and 1/2 hopper filling.

Table 5: Mean values of missing index (%), Mean number of multiples (%), Mean depth of placement (cm) and Mean field efficiency (%)at different level of hopper filling

Filed test	Hopper filling		
	Full	¾	½
Mean missing index, %	3.02	2.33	1.25
Mean number of multiples, %	13.25	11.79	11.26
Mean depth of placement, cm	6.25	5.87	5.77
Mean field efficiency, %	77.28	76.85	76.29

3.4 Mean values of missing index (%), Mean number of multiples (%), Mean depth of placement(cm) and Mean field efficiency (%) at at different Forward speed of seed sowing machine

The mean values of missing index and number of multiple of three different level of forward speed were compared and are given in Table 6.It shows that the mean values of missing index for all three levels were significant. It also shows that on 3.58 km/hr Forward speed, missing index and number of multiple was highest.

The mean values of depth of seed placement and field efficiency of three different level of forward speed were compared and are given in Table 6. It shows that the mean values of depth of seed placement and field efficiency for all three levels were significant. It also shows that on 2.15 km/h forward speed, depth of seed placement and field efficiency were highest. Difference between all 3 forward speed was found negligible. The depth of placement increases with decrease in Forward speed due to decrease in jerk with forward speed.

Table 6. Mean values of missing index (%), Mean number of multiples (%), Mean depth of placement(cm) and Mean field efficiency (%) at different Forward speed of seed sowing machine

Test	Avg. Forward speed, km/h		
	2.15	**2.87**	**3.58**
Mean missing index, %	2.46	1.27	2.88
Mean number of multiples, %	11.91	10.5	13.96
Mean depth of placement, cm	6.03	6.01	6
Mean field efficiency, %	81.68	78.69	70.05

3.5 Combined effect of hopper filling and ground wheel revolution on mechanical damage

The combined effect of hopper filling and forward speed and their interaction on the change in mechanical damage and seed rate. The mean values of the mechanical damage and seed, their non-significance. The highest value of seed rate and mechanical damage in full hopper and 50 rpm forward speed.

Table 7. Combined effect of hopper filling and ground wheel revolution on mechanical damage and seed rate

Factors	Ground wheel, Rpm	Hopper filling		
		Full	¾	½
Seed rate, kg/ha	**30**	63.2	63.1	60.12
	40	64.56	63.9	60.99
	50	66.34	65.78	61.66
Mechanical damage, %	**30**	1.2	1.21	0.42
	40	1.57	1.32	0.73
	50	2.19	2.07	1.02

3.6 Effect of interaction of hopper filling and forward speed on missing index (%), Mean number of multiples (%), Mean depth of placement(cm) and Mean field efficiency (%)

The combined effect of hopper filling and forward speed and the irinteraction on the change in missing index, Depth of placement, Field efficiency and number of multiples. The interaction between hopper filling and forward speed was found non-significant at 5percent level of significance. The highest value of missing index and number of multiples in full hopper and 3.58 km/hr forward speed and the highest value of depth of seed placement in full hopper and 2.15km/h forward speed, The highest value of field efficiency in 3/4 hopper and 2.15 km/h forward speed.

Table 8: Effect of interaction of hopper filling and forward speed on missing index (%), Mean number of multiples (%), Mean depth of placement (cm) and Mean field efficiency (%)

Factors	Forward speed, km/h	Hopper filling		
		Full	¾	½
Missing index, %	**2.15**	3.63	2.4	1.35
	2.87	1.42	1.39	1
	3.58	4.02	3.22	1.42
Number of multiples, %	**2.15**	12.35	11.32	12.06
	2.87	11.4	10.05	10.05
	3.58	16	14	11.67
Depth of placement, cm	**2.15**	6.2	6	5.9
	2.87	6.25	5.9	5.9
	3.57	6.3	5.9	5.8
Field efficiency, %	**2.15**	81.78	82.25	81
	2.87	79.97	79.04	77.05
	3.58	70.08	69.25	70.83

Conclusion:-

The chickpea sowing by battery operated seed sowing machine, sufficient seed rate was found as 63.20 kg/ha, mechanical damage 1.20 %,missing index 3.63 %, number of multiples 12.35 %, and 81.78 % field efficiency at 2.15km/h on full hopper filling.The chickpea sowing sufficient seed rate were found in 40 ground wheel rpm and 3/4hopperfilling. During lab testing the average mechanical damage of chick pea seed found 1.34%. The depth of seed placement by the developed seed sowing machine was 4.5 to 10 cm range. The performance of the developed seed sowing machine found better at 3/4 hopper filling as comparedtofulland1/2hopperfilling.The performance of the developed seed sowing machine found better at 40 rpm speed as compared to 30 and 50 rpm speed, due to required optimum seed rate and minimum mechanical damage of the seeds.

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