Annals of Arid Zone 60(3&4): 153-154, 2021

Short Communication

Modification of Traditional Tractor-Drawn Seed Drill for Arid Region Crops

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Received: December 2021

Time of sowing has a dominant effect on the germination of seeds and growth. The establishment of desired seed population is probably the most critical phase in the life of the crop. The role of the seed drill to provide a link between seed and soil is very important. Before 1960, the traditional methods followed for sowing of seeds were hand broadcasting, opening furrows by the wooden plough and dropping seeds by hand in the furrows, or dropping seeds in the furrows through the bamboo tube attached to the wooden plough. These methods did not uniformly distribute or accurately place the seeds at the desired depth leading to reduced plant population and hence resulting in poor yield. The more precise the sowing operation, the better the quality of crop harvested. Precision sowing reduces seed scattering and excessive use of seeds due to uniform distribution of seeds and by preventing the seed from bouncing in the furrow, which facilitates drill calibration based on the number of seeds to be placed along a unit length of the row (Gautam *et al*., 2019). Uniform germination and growth of plants make the subsequent operations, such as weeding and harvesting, easy with low costs (Singh and Yadav, 2014; Tayade, 2018).

There are so many sowing implements designed, improved, and modified to meet the seeding requirements of different crops. Sharma *et al.* (2001) improved the tractor-drawn ridger seeder and developed a multipurpose tractor-drawn seeding machine which could accomplish sowing of crops both on flatbeds as seed cum fertilizer drill and in the ridge-furrow system as ridger-seeder with slight modifications/adjustments. It was capable of sowing 5-6 ha day^{-1} depending on type of crop sown, about 12-15% higher yields and 30-40% saving of irrigation water with its use as ridger-seeder. Kishore and Verma (1985) evaluated eight different seeding and fertilizer application method for sowing of wheat in silty-loam soil. The result shows that wheat sowing gives a 32.41% higher yield with 41.22% and 50.39% savings in manual and animal energy, respectively. The saving of 58.51% was also recorded in the cost of sowing wheat as compared to the traditional method of sowing and fertilizer application. Ghosal and Pradhan (2013) developed a low cost manually operated multi-crop seed drill with suitable dimensions of a cup in cup feed metering mechanism for a particular crop and evaluated in the field condition to study its seed pattern characteristics and economic viability for small and marginal farmers in the state of Odisha. So, seeding requirements vary to crop type, environment, and soil type.

Crop production under the rainfed situation in arid regions largely depends upon the amount and distribution of rainfall. The sowing date has a considerable effect on the production and productivity of dryland crops (Singh *et al*., 2007). In kharif under rainfed situations, the onset of monsoons is the single most factor deciding sowing time. The onset of rainfall may be delayed by a few days to even more than four weeks compared to the normal dates of sowing. Under such situations, sowing of the crops gets delayed and the dry seeding practice of legumes and transplanting of pearl millet has been tried to compensate for the delay in sowing time. If rains are delayed for a substantial period, the crops suitable for the timely onset of rains may not perform well under delayed conditions. Delay in the sowing operations not only prevented rapid differentiation but also allowed phenological stages to coincide with required atmospheric factors like photoperiodic and thermal regimes.

In the arid region, the crops are generally sown either by broadcasting method or by creating small furrows with the help of a tractor-drawn cultivator-based sowing device provided with a tyne-type furrow opener. A person sits

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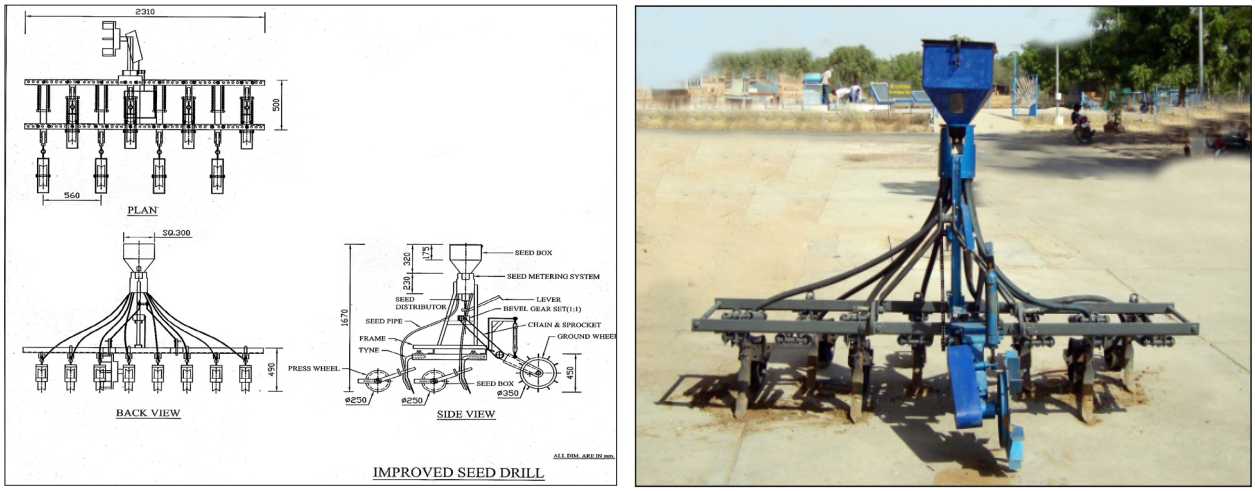

Fig. 1. A view of the improved traditional seed drill.

on the sowing device itself facing opposite to tractor operator, which is uncomfortable and health hazardous because of inhaling dust and dirt. In addition, the traditional sowing method is not only time consuming but also requires more labour. The seed is continuously poured manually onto a pointed wooden cylinder, which may get time delayed because of picking up of seed from a bag, and also no seed pressing device is provided. This leads to poor germination and uneven distribution of seed. To overcome the problem, an improved traditional seed drill was developed to obtain the optimum environment for germination of seed and growth of seedling under available soil moisture in the field. To obtain the optimum environment for germination of seed and growth of seedling in the arid region, some modification in traditional tractor-drawn seed drill for arid region crops has been done in fabrication workshop at ICAR-Central Arid Zone Research Institute, Jodhpur.

A tractor-drawn three-point linkages angle iron frame having 2200 mm length, 500 mm width and 475 mm height has been fitted with 8 spring tynes and reversible type furrow openers each 300 mm apart. Tyne was fitted with a 40 mm dia MS pipe for fixing plastic pipe which facilitates dropping of seed in the furrow.

Seed metering system consists of a trapezoidal shape GI sheet hopper (400 x 400 x 370 mm) for containing seed with lid cover and inspecting window (70 x 100 mm) to check the availability of seed inside the seed box during sowing operation, a circular body having dia 150mm and 200 mm height was also facilitated with 8 circular openings (25 x 25 mm) at the bottom periphery for connecting plastic pipe for dropping seed in the furrow. Seed rates were set as per the different variety of seed i.e. 3-4 kg ha^{-1} in case of pearl millet and 10-12 kg ha^{-1} for mung bean, moth bean, and clusterbean. A pin of 12 mm dia and 85 mm long has been fitted at the center of the ground wheel to transmit the rotational power through chain and sprocket assembly to the seed metering system.

The press wheel made up of MS is fabricated in two parts, each part is having a 245 mm dia and 35 mm slant surface, both the parts of press wheel were bolted on 350 mm long and 110 mm wide MS flat frame. A set of press wheels has been fitted with each tyne of cultivator by a MS flat clamp which helps to keep the press wheel in a straight and balancing position during the forward movement of the seed drill. The main advantage of the seed drill is that the seed metering system and press wheel assembly are mounted on the cultivator which makes it a low cost seeding device. The seed metering system and press wheel can easily be removed out after performing sowing operation. The cultivator then can be used for tillage operation.

Refinement in the metering system and press wheel

The improved traditional seed drill with a metering system was calibrated for proper seed rate. The bit and bush assembly was set to regulate the openings for uniform metering of different shapes and sizes of seeds. The press wheel assembly was also adjusted on a frame to provide uniform pressure in each furrow throughout its field operation.

Fig. 2. Seed rate marked on seed box.

crop parameters were equal, a paired *t*-test was performed at of 5% level of Significance.

Pearl millet, mung bean, moth bean, and clusterbean were sown at the field capacity, 0.60 ha hr^{-1} by using the improved traditional seed drill and conventional method of sowing (Fig. 3) during kharif season and mustard during rabi season. Crop parameters, viz., number of plants per square meter, plant height, number of branches per plant, number of pods per plant, pod length, and number

Fig. 3. Sowing by improved traditional seed drill (a) and sowing by traditional seed drill (b).

Performance of the improved traditional seed drill was tested in the laboratory for pearl millet, mung bean, moth bean, clusterbean and mustard seeds. The bit of the metering device was equally divided and marked (Fig. 2). The adjustment of bit was given on the seed box as per the shape and size of seeds to maintain its seed rate under field conditions. To test the hypothesis that the improved seed drill and traditional sowing method means at different

of grains per pod were significantly better in crops sown using the improved seed drill compared to traditional seed drill (Table 1). The total crop yield has been increased by 18-20% over the traditional method of sowing. Similarly, many studies have been reported that the crop yield increased with mechanized seeding (Singh *et al.*, 2006; Khobragade *et al.*, 2011; Tayade, 2018). The higher yield has been obtained because of proper placement of seed

Table 1. Yield and the crop parameters for pearl millet, mung bean, moth bean, clusterbean and mustard

Crops and variety	Plants (Nos. m^{-2})		Plant height (cm)		Branches (Nos. $plant^{-1}$)		Pods/ear head (Nos. $plant^{-1}$)		Pod/ear head length (mm)		Crop yield (q ha^{-1})	
	I	II	I	II	I	II	I	II	I	II	I	II
Pearl millet	13	11	171	160	6	5	5	4	240	230	10.8	9.4
Mung bean	25	19	57	52	5	4	19	17	67	58	6.7	5.8
Moth bean	26	24	33	37	5	4	76	69	52	48	6.4	5.6
Clusterbean	22	19	68.5	56.5	4	3	25	21	64	59	5.7	5.1
Mustard	35	27	155	140	8	6	945	846	7	6	10.8	9.2
Mean	24.20	20.00	96.90	89.10	5.60	4.40	214.00	191.40	86.00	80.20	8.08	7.02
SD	7.92	6.08	61.94	56.24	1.52	1.14	409.52	366.76	87.69	86.49	2.51	2.10
t Stat	3.50		2.32		6.0		1.18		3.50		5.62	
p-value	0.013		0.041		0.002		0.151		0.012		0.003	

* I: Improved traditional seed drill, II: Conventional sowing method.

and early germination due to the press wheel in the improved traditional seed drill.

To overcome the problem of the traditional seed drill, an improved traditional seed drill was developed to obtain the optimum environment for germination of seed and growth of seedling under available soil moisture in the field. Arid region crops were sown with a field capacity, 0.60 ha hr^{-1} during the season to evaluate field performance of improved traditional seed drill. Plants per meter square area were found significantly higher than the traditional seed drill. The total crop yield has been increased by 18-20% over the traditional method of sowing. Thus, the improved seed drill performs better than the tradition seed drill.

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Printed in December 2021