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Horsegram (*Macrotyloma uniflorum*) production technology: A review

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Abstract

Horsegram (*Macrotyloma uniflorum*) is one of the important pulse crops with the unique characteristics with tolerance to various biotic and abiotic stresses. This crop has the ability to be grown under rainfed situations in marginal lands and can be considered as a climate resilient crop. Still, it has not attracted due attention and has been underexploited. This is a late kharif crop mostly sown in the month of August or even during July depending upon local climatic conditions. Line sown horsegram crop maintains proper plant stand, hence is considered as the suitable sowing method to obtain desirable yield. Depending on variety used and growing environment, a plant population of 3.33 to 4.44 lakh/ha is recommended by various researchers to harvest good yield. Among various plant nutrients, phosphorus plays a vital role to enhance the yield through accelerating root and shoot growth. With proper agronomic management practices, horsegram can provide potential yield, even under unfavourable situations.

Keywords: Horsegram, *Macrotyloma uniflorum*, production technology

Introduction

Pulse crops contribute immensely for ensuring nutritional security and maintaining soil health. Horsegram (*Macrotyloma uniflorum* (Lam.) Verdc. is an important pulse crop that can be grown under stress condition with poor crop management practices. It has wider adaptability with resistance to several diseases and tolerance to biotic and abiotic stresses. Yasin *et al.*, (2014) [38] opined that horsegram can thrive in a wide range of geographical locations with variation in water availability. When compared with other crops, horsegram performs better under drought situations (Sharma *et al.*, 2016) [31]. The typical agronomic characters enable the crop to thrive well in drylands and under marginal conditions, for which it is considered as a climate resilient crop (Reddy *et al.*, 2018) [29]. The grain has several medicinal properties and traditionally used for treatment of various disorders like kidney stone, diabetes and joint pain (Handa *et al.*, 2017) [8]. As a food, horsegram contains adequate quantity of protein, carbohydrate, fibre and micronutrients (Jacobs and Steffen 2003; Yadav *et al.* 2004) [9, 37]. This is also used as cattle feed in different regions in India (Kumari *et al.*, 2016) [15].

In spite of these, horsegram has been underexploited though it can play an important role in sustainable agriculture practices. In India, the productivity of this crop is visibly low due to various factors such as growing crop in low productive soils, application of low level of input and absence of improved varieties (Alle *et al.*, 2014) [1]. There is vast scope to enhance the productivity of horsegram by proper agronomic practices such as tillage, sowing method and nutrient management (Raut *et al.*, 2016) [28].

Sowing time

Date of sowing plays a deciding role to obtain expected yield from any crop. Depending on the period of monsoon, quantity & distribution of rainfall and soil moisture content; there is variation in date of sowing from region to region (Maruthi *et al.*, 2018) [17]. In many places, this crop is sown during the month of August as a contingent crop in case of crop failure due to early season drought during kharif season. This is because of the potentiality of the crop for drought tolerance and ability for nitrogen fixation. Under Hyderabad situation, Yasin *et al.*, (2014) [38] observed that horsegram crop does not switch over to the reproductive phase if sown during June because of the photo- and thermo-sensitive nature of the plant. There is reduction in yield obtained from the crop sown during September due to inadequate rainfall at

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pod filling stage. For Hyderabad region, the optimum date of sowing is second fortnight of August (Maruthi *et al.*, 2018)^[17]. But under Solapur situation, Shinde *et al.* (1993)^[32] reported reduction in grain seed yield when sowing was delayed beyond first fortnight in July.

Sowing method

The sowing method of horsegram varies from region to region depending on the soil condition, rainfall pattern and conventional crop production practices. Observations of various researchers at different locations revealed that variation in tillage conditions significantly influenced the yield of grain. Basavarajappa *et al.* (2003)^[3] recorded the maximum grain yield (550 kg/ha) with medium tillage and ridging, which was followed by shallow tillage and ridging (522 kg/ha). Kumar *et al.* (2010)^[14] obtained highest grain yield of 1.11 t/ha by ridge sowing, which was statistically at par with zero tillage sowing (1.04 t/ha) due to encouraging growth and development of the crop.

Raut *et al.* (2016)^[28] obtained maximum yield of grain (972 kg/ha) and straw (1999 kg/ha) by adopting conventional tillage method with dibbling. When various plant spacings were compared, sowing at a distance of 45 cm×6.5 cm yielded maximum grain due to taller plants, more number of branches per plant, higher number of pods per plant and higher number of seeds per pod (Prakash *et al.*, 2007)^[27].

Sowing the seeds in line also influenced the yield of horsegram at various locations. Nagaraju *et al.* (1995)^[19] observed that sowing of seeds in row resulted in higher yield (871 kg/ha) as compared to broadcasting (631 kg/ha). Use of seed drill for sowing helps in maintaining optimum plant population thereby ensuring good yield. Thiyagarajan *et al.* (2020)^[35] reported that use of seed drill for sowing recorded 75 & 74 per cent increase in plant height, 41 & 29 per cent increase in number of leaves and 346 & 180 per cent increase in number of plants per square meter at 30 DAS & 60 DAS, respectively when compared to broadcasting method.

Priming of seeds has positive effect on the yield and yield attributing parameters of horsegram due to better germination. Chakraborty *et al.* (2007)^[4] reported enhancement in these parameters such as 9.4 per cent more germination, 12.8 per cent more plant stand at harvest, 6.5 per cent more pods per plant, 6.4 per cent more branches per plant and 9.6 per cent higher yield with priming of seeds as compared to the sowing unprimed seeds.

Plant population

Plant population plays a vital role in deciding the yield of horsegram. The yield is drastically affected by inadequate plant stand, although the performance of individual plant is better in the plots having low plant stand. Several authors have reported different planting density for obtaining good yield from horsegram. Keshava *et al.* (2006)^[12] obtained maximum grain yield of 912.4 kg/ha with a plant population of 4.44 lakh/ha, which was 26 and 60 per cent higher than that of the yield obtained from the planting density of 3.33 lakh/ha (723.9 kg/ha) and 2.66 lakh/ha (569.6 kg/ha), respectively. But, Maruthi *et al.* (2018)^[17] reported that a plant population of 3.33 lakh/ha was found suitable to harvest maximum yield under Hyderabad and Tirupathi situations. Competition among the individual plants under higher plant density of 4.44 lakh/ha resulted in lower values of various yield attributing parameters such as pods per plant, seeds per pod and seed weight as compared to medium (3.33 lakh/ha) and lower (2.66 lakh/ha) plant densities (Keshava *et al.*, 2006)^[12]. Under

Bengaluru situation, Nagaraju *et al.* (1995)^[19] recorded the highest yield with minimum row spacing of 15 cm during rainy season. Keshava *et al.* (2007)^[13] observed that crops with dense plant stand having closer row spacing possessing good network of root volume per unit area resulted in higher uptake of plant nutrients from the soil. Chandranath and Hosmani (1995)^[5] from Dharwad obtained more grain yield with a row spacing of 30 cm when compared with the row spacing of 22.5 cm or 37.5 cm. Nagaraju *et al.* (2002)^[20] reported similar findings with significantly higher grain yield with row spacing of 30 cm as compared with the row spacing of 45 cm.

Seed rate

Plant population of a crop is directly influenced by the quantity of seeds sown. Hence, seed rate plays a vital role in deciding the plant population thereby yield of the crop. Kalita *et al.* (2003)^[11] recorded the highest grain yield (9.41 q/ha) and the maximum number of pods/plant (39.57) with a seed rate of 25 kg/ha, which was statistically similar to the yield obtained from the crop sown with 20 and 30 kg seed/ha. Under Odisha situation, Patra and Nayak (2000)^[24] reported 14.8 per cent higher yield with the seed rate of 30 kg/ha as compared to 20 kg seed/ha. They have also reported 14.4 per cent more yield from line sown crop over broadcast method. However, under Nigeria situation, Omokanye *et al.* (2002)^[23] recorded the maximum yield of seed and fodder when 12 kg seed/ha was sown through drilling method.

Intercropping

Horsegram can be suitably intercropped with other crops to enhance yield and profit. Several researchers have suggested various combinations of intercrop with horsegram. Kumar *et al.* (2010)^[14] reported the highest horsegram equivalent yield of 1.75 t/ha from horsegram + maize (cob) intercropping, which was statistically at par with horsegram + finger millet intercropping system (1.57 t/ha). Pradhan *et al.* (2018)^[26] from Chhattisgarh observed maximum finger millet equivalent yield from intercropping of finger millet with horsegram at a row spacing of 30 cm with two weeding, may be due to minimum weed population resulting in less inter-specific and intra-specific competition as compared to other intercropping systems.

Nutrient management

Many times, due importance is not given on plant nutrients while growing horsegram for which the yield is remarkably affected. As a subsistence crop, horsegram is grown without application of fertilizer and the crop depends on inherent soil fertility for its growth and yield. Scientific management of plant nutrients in the crop can substantially increase the grain yield and profit. Narayanan and Anuradha (1991)^[21] reported that phosphorus deficiency decreased leaf area and plant dry weight, but increased the root: shoot ratio.

Being a leguminous crop, horsegram can meet a part of its nitrogen requirement by way of nitrogen fixation (Basavarajappa *et al.*, 2003)^[2]. Halemani *et al.* (1989)^[7] recorded 61 per cent higher grain yield with application of 25 kg N/ha as compared with untreated control. Verenkar and Thorat (1988)^[36] also reported increase in dry matter accumulation throughout the growth period and increase in seed yield from 683 to 952 kg/ha with increase in nitrogen dose from 0 to 37.5 kg/ha. Some researchers have reported positive results by application of nitrogen through *Rhizobium* inoculation. Seed inoculation with *Rhizobium* culture

enhanced the number of nodules and production of maximum number of pods (12/plant) and seeds (84/plant) as compared with untreated crop (Kala *et al.*, 2011) [10]. Prabakaran *et al.* (1999) [25] reported the highest seed yield of 735 kg/ha with dual inoculation of *Rhizobium* and phosphobacteria along with 40 kg P₂O₅ per hectare.

Phosphorus plays a distinct role in plant growth and development of horsegram crop. Under Dharwad situation, Chandranath and Hosmani (1995) [5] recommended application of 30 kg P₂O₅/ha for optimum grain yield (1205 kg/ha). Keshava *et al.* (2006) [12] realized maximum grain yield of 788.8 kg/ha with application of 60 kg P₂O₅/ha, which was at par with the yield obtained by application of 30 kg P₂O₅/ha (783.9 kg/ha). Under Nigeria situation, Omokanye *et al.* (2000) [22] observed that increase in rate of phosphorus application up to 80 kg/ha increased the days to pod maturity, seeds per pod and grain yield (946 kg/ha).

Application of P₂O₅ @ 60 kg/ha recorded significantly higher phosphorus uptake (8.42 kg/ha) as compared to application of 30 P₂O₅kg/ha (7.26 kg/ha) or the control (5.65 kg/ha), may be due to better spread of roots and increase in the nodulation efficiency, which might have enabled the plant to absorb more nutrients from the soil (Keshava *et al.*, 2007) [13]. Under rainfed conditions at Bangalore, Nagaraju *et al.* (1998) [18] reported increase in seed yield by application of P₂O₅ up to 40 kg/ha and S up to 20 kg /ha. But on a sandy loam soil in Rajasthan, Singh and Singh (1992) [33] recorded increase in seed yield with P application up to 8.8 kg/ha. Verenkar and Thorat (1988) [36] realized the maximum seed yield with application of 60 kg phosphorus/ha.

Combined application of nitrogen and phosphorus had different results as reported by several workers. Under Hyderabad situation, Maruthiet *et al.* (2018) [17] recorded comparable performance 20 kg P₂O₅/ha either with 10 kg N/ha or without nitrogen application. Choudhary and Singh (1994) [6] obtained increase in yield up to 10 kg N and 17.6 kg P/ha. They also observed that N application delayed maturity, whereas P and Zn applications hastened maturity. Under Odisha situation, Patra and Nayak (2000) [24] reported increase in yield by 51.5 and 31.6 per cent with application of 20 kg N/ha and 17.5 kg P/ha as compared with no N and P application, respectively. Halemani *et al.* (1989) [7] reported higher grain yield with application of 25 kg N/ha and 40 kg P₂O₅/ha as compared with the untreated control due to the consequence of increase in number of pods/plant, pod weight and seed weight. Combination of P₂O₅ @ 25 kg/ha along with K₂O @ 10 kg/ha yielded maximum seed (776.4 kg/ha) as compared with no NPK application (451.4 kg/ha) (Sasidhar *et al.*, 1983). Under Odisha situation, Lenka *et al.* (1989) [16] realized maximum grain yield with application of 10 kg N and 20 kg P₂O₅/ha to rainfed crops and 20 kg N and 60 kg P₂O₅/ha to irrigated crops.

Under Dapoli situation, Raut *et al.* (2016) [28] recorded maximum yield of grain (1005 kg/ha) and straw (2004 kg/ha) with soil application of 100% RDF. But, Swain *et al.* (2019) [34] reported that incorporating crop residues after kharif crop along with balanced fertilizer application with 75% RDN and 25% N through organic source had positive response on yield. Strong potentiality of horsegram crop for nitrogen fixation resulted in higher values of shoot growth and root growth along with more yield and protein content of grain due to seed inoculation with *Rhizobium* culture (Kala *et al.*, 2011) [10].

Weed management

Presence of weeds in the field is another important factor influencing the growth and yield of the crop. Several researchers have attempted to determine suitable weed management options in horsegram. Anitha *et al.* (2003) [2] recorded the lowest total dry weight of weeds (28.91 g/m²), highest seed yield (340 kg/ha) and maximum net return (Rs. 2331/ha) with application of pretilachlor followed by hoeing at 20 DAS. Under Odisha situation, Patra and Nayak (2000) [24] realised yield increase by 12.2 per cent with one hand weeding at 25 days after sowing over unweeded plots. On the other hand, Nagaraju *et al.* (1995) [19] recorded higher yield of 834 kg/ha with two hand weedings as against the yield of 668 kg/ha in the control plots.

Desirable yield can be obtained from horsegram crop by adopting scientific approaches of crop management. This can be a potential crop to obtain higher yield and more profit, even under unfavourable situations. This can also be taken up as a catch crop under mid-season crop failure due to natural disasters.

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