

Production Technology of Relay Chickpea under Rice Fallow for Sustainable Agriculture

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Abstract—Relay chickpea means chickpea seed sown before harvesting of rice. This practice is followed in West Bengal, Bihar, Orissa and some other states of India. In low and medium land soil conditions rice is harvested in late month of December. Late harvested rice field and its preparation for next crop takes time up to month of January and ultimate second crop sowing time is over. In Bihar, West Bengal and Orissa vast land is remain fallow due to this reason. But relay cropping is one of the options for growing second crop as a pulse for sustainable agriculture. Relay chickpea has a smart technology for higher production per unit area. Higher production of relay chickpea under rice fallow also reported compare to traditional chickpea cultivation. Smart technology indicates chickpea seed sowing under optimum soil moisture conditions otherwise it may fail germination ultimate yield loss. It is also beneficial for chickpea where short duration paddy grown which vacate fields in September-October according to previous history of the land and moisture availability. Optimum plant population can only be ensuring in well levelled land, sufficient soil moisture and good seed under relay cropping. Seed inoculated with suitable strain of rhizobium at the rate of 20 g per kg of seed after seven days of fungicides treatment. Seed treatment with fungicides like carbendazim at the rate of 2 g per kg seed should be done. Efforts should be made to choose disease-resistant varieties to control root rot and blight. Overnight soak seed is broadcasted at the rate of 20-25 % higher seed rate of recommended seed rate for optimum plant stand. Fertilization is advisable during or before chickpea seed sowing for better uptake and nutrient solution like urea and DAP at the rate 2% foliar spray before flowering.

Keywords: Relay Chickpea, Rice fallow, Sustainable Agriculture.

1. INTRODUCTION

Chickpea or Bengal gram or Brown gram or White gram or Kabuli gram (*Cicer arietinum* L.) is widely grown in winter season in India. Chickpea is used as different purposes i.e. consumed as leafy vegetable, boil chickpea, roasted chickpea, green pod, chana dal, flour (Besan), horse feed as well as fodder. Variety of snacks, sweets and dishes can be made out of chickpea flour. Seed contains around 25% proteins and 60% carbohydrates. The desi type of chickpea contributes to around 80% and the Kabuli type around 20% of the total production. India is the largest producer of chickpea

contributing to around 70% of the world's total production. In India, Chickpea production was 7170 thousand tonnes in 2015-16 whereas in 2013-14 it was 9530 thousand tonnes [2].

The location specific production technology of relay chickpea under rice fallow for sustainable agriculture is validating. Stepwise agronomic measures have to be taken for relay chickpea under rice fallow. Preceding and succeeding crop between this transition phases is very much important for establishment of chickpea crop. Before physiological maturity of rice, soaked chickpea seed broadcasted with proper soil moisture for better germination of the seed. Well levelled land for maintaining soil moisture in uniform mode in which uniform soil moisture can be obtained, and it also facilitates uniform germination of seed. The planting geometry of rice crop also plays an important role for higher production of succeeding *paira* chickpea crop, overcrowding is strictly avoided. Machine transplanted or line transplanted rice crops gives higher yield itself rather it also gives higher yield of chickpea; it facilitates better aeration and less pests and diseases attack. In clay to clay loam soil with better water holding capacity is suitable for chickpea crop. The residual soil moisture of this soil is sufficient for chickpea plant growth and development [4]. In rice fallow situation chickpea intervention shows as a low-cost compare to other interventions like wheat and potato which is highly profitable crop that can be cultivated without irrigation under residual soil moisture. Well soaked seed is beneficial for ensuring germination percentage of chickpea crop. The seed-priming technology gives better results than non-primed fields [3]. In this cropping, land not cultivated, no basal application of chemical fertilizers, only bio fertilizers like rhizobium, PSB and KSB is used which is eco-friendly. *Trichoderma viride* are used as seed inoculation during seed sowing for controlling wide spectrum of fungi. Sustainable agriculture indicates good soil health management; weed management, insect and disease management which shows in relay chickpea under rice fallow.

2. RICE FALLOWS DENOTED BELOW-

Rice fallows are those land which remain fallow during winter season after harvesting of *kharif* rice. Relay cropping are generally practiced in other pulses crop in rice fallow areas [1]. It is also called relay crop/ *utera* crop, *paira* crop /zero tilled crop /residual crop which is followed after rice.

3. AREA UNDER RICE FALLOW IN INDIA

A total rice fallow area in India is about 11.65 mha. Eastern part of India covered about 4.22 million ha which comprises districts are eastern UP, Bihar, Jharkhand and West Bengal. North east hill region namely Assam area covered 0.54 million ha. Central region of India 5.01 million ha area comprises districts are Madhya Pradesh, Chhattisgarh and Maharashtra. Rice fallow area in coastal region is about 1.52 million ha; districts are Andhra Pradesh, Odisha and Tamil Nadu.

4. REASON BEHIND OF RICE FOLLOWED BY FALLOW

1. Lack of awareness of pulse production in winter
2. Early withdrawal of monsoon rains
3. Not availability of watershed or farm pond for life saving irrigation
4. Unavailability of inputs particularly good variety of seed and micronutrients
5. Water logging and excessive moisture in the months of November and December in low land conditions
6. Lack of appropriate varieties of winter pulse crops for late planting
7. Socio-economic problems like stray cattle, blue bulls etc. which is a menace to the farmers
8. Poor marketing facilities for sell their produce with minimum support price
9. Not availability of pulse (*dal*) processing mill or mini *dal* mill
10. Unavailability of modern seed sowing and harvesting machinery

5. RELAY CROPPING

Relay cropping is sowing of crop before harvesting of the main crops. Relay cropping is followed where late transplanting long duration rice harvested in late with high soil moisture and water is scarcity to save the second crop at a later stage. Due to high soil moisture during rice harvesting, fields take another 15 to 20 days for proper soil moisture for sowing of second crop in low to medium land conditions of West Bengal and other some states [3]. The production

technologies have to adopt for utilization of vast fallow land for sustainable agriculture, nutritional, and food security.

6. AGRONOMIC MEASURES FOR IMPROVING PRODUCTIVITY

6.1 Land of seed sowing

In this cropping system land preparation is not required. Only imbibed seed are sown in standing rice crop with proper soil surface moisture before 10 to 15 days of harvesting. After harvesting of rice, chickpea seedlings already established. Few thumb rules are essential for relay chickpea: (1) Relay cropping: sowing of chickpea seeds in standing crop 15 days before of harvesting of rice; it ensures germination of seeds where soil moisture is the key factor for its establishment. (2) Overnight imbibed seed are used to facilitate good germination to avoid seed drying.

6.2 Seed rate

The seed rate of 100 to 120 kg/ha is recommended for relay chickpea, 20-25 % higher seed rate of normal seed rate is generally used to avoid germination failure. Method of sowing is broadcasting. Timely sowing of relay chickpea is October and November months.

6.3 Varieties

Choice of variety is depend on time of sowing. If it is possible to sow the seed in the month of November then normal sown variety have to use. If land is vacate in the month of December then late sown sowing seed should be used. Any recommended variety of this region can be used. Some chickpea varieties is performing well in this regions e.g. Pusa 372, Pusa 547, HK-4 (HK-05-169) KWR-108, KPG-59, PG 186, JG 315, JG 16, JG 14, Bidisha, Vaibhav, BG-1003, GCP-105 (Gujarat Gram -4) and Annigiri.

6.4 Seed treatment and inoculation

Before sowing, seed should be treated with fungicides followed by *rhizobium* and *Trichoderma viride*. The seed should be treated first with fungicides bavistin @ 2 g/kg seed at least seven days before. *Rhizobium* and *Trichoderma viride* inoculated with seed @ 20 g/kg seed with suitable strain. Seed inoculated with *rhizobium* PSB @ 20 g/kg seed for soil phosphorus solubilization [5].



Relay chickpea at branching stage



Relay chickpea at pod development stage

6.5 Nutrient management

Basal application of fertilizer is not possible in relay Chickpea. Under nutrient deficient condition nutrient solution like urea and DAP at the rate 2% is foliar sprayed at vegetative stage or before flowering. Foliar spray of urea/DAP to supplement N and P @ 2 % in case of relay cropping is recommended. In micronutrient deficient soil, Mo, B and Zn can be used as foliar spray [5].

6.6 Weed Management

Manual one or two hand weeding is followed at 25 to 30 days or 45 to 50 days after sowing depending upon weed seed bank to control weed. Pre-emergence herbicide like pendimethaline @ 4-5 litre with 400-500 litre of water per hectare. Post-emergence herbicides like Quizalofop ethyl.

6.7 Insec-pests and Diseases

Pod borer (*Helicoverpa armigera*) are the serious insect of chickpea. Insect-pests are controlled through application of pesticides according to types of pest for effectiveness. Mostly pod borer (*Helicoverpa armigera*) at branching and pod development stage is infested more. To control this insect Pheromone trap (Helico-lure) is used at the rate of 8 numbers/ha. Neem seed kernel extract at the rate of 5% spray is also beneficial [4].

To control soil borne pathogen liquid formulation of *trichoderma harzianum* may be sprayed in wet soil. Effective control of all fungal diseases can be achieved through seed treatment with *trichoderma harzianum* or *Pseudomonas fluorescens* @ 20 g/kg seed.

6.8 Life saving irrigation

Rice straw cutting at 30 cm height is very much beneficial for soil moisture conservation. It facilitates sufficient soil moisture during crop period. Life saving irrigation is beneficial where water is available for higher seed yield.

6.8 Yield (kg/ha)

Relay chickpea always performed well because plants get sufficient time in the field, less disease and pest infestation

compare with conventional tillage and others tillage management practices in alluvial zone of West Bengal.

An experiment was conducted during 2016-17 and 2017-18 on relay cropping and others tillage management practices at State seed Farm (AB-Block), BCKV, Kalyani, Nadia, West Bengal. Two years (2016-17 and 2017-18) experiment concluded that in both the years relay chickpea yielded significantly highest 1443 kg/ha and 1413 kg/ha respectively compare to others treatments.

Table 1: Effect of tillage management practices on yield of chickpea

Treatments	Yield kg/ha	
	2016-17	2017-18
CT+L = Conventional tillage (two harrowing + planking) followed by line sowing	1156	1103
DSMP = Direct seeding in un-tilled field with plough (manually)	1083	1292
DSZTD = Direct seeding in un-tilled field with zero till drill	979	1173
RT+ L = Zero/reduced tillage (one harrowing +planking) followed by line sowing	1126	1018
BS+ RT = Broadcasting seed followed by reduced tillage (one harrowing + planking)	990	953
RELAY = Broadcasting seed in standing rice before 15 days of its harvest (relay crop)	1443	1413

Source: AICRP on Chickpea, BCKV, Kalyani, Nadia, West Bengal

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