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Quality Seed Production through Pulses Intervention in Rice-Wheat Cropping System

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Quality seed production of pulses is prime goal for fulfillment of pulse demand of country besides increasing system productivity in terms of soil fertility restoration and economic gain to farmers. The IGP is one of the major important areas (about 10 million ha area under RWCS) contributing towards total food grain production in India, inclusion of pulses as catch crop, intercrops, and diversification and/or substitute of rice with pulses may be important areas for production of quality seed of these crops.

Introduction

Pulses are important source of dietary protein for most of people in developing world including India, because most of the population is vegetarian. India is the largest producer (17.29 million t in 2011-2012) and consumer of pulses in the world but low average productivity (694 kg/ha in 2011-12) for most of the pulses (Anonymous, 2012). Seed is the most vital and basic input for sustained agricultural production in enhancing crop productivity. Since the total cultivable area is decreasing due to ever growing population and urbanization, the increased agricultural productivity is the only option for food and nutritional security. Hence, in modern agriculture, quality seed is of vital significance. Use of quality seeds alone could increase 20-25 % of the crop yield. Modernization of agriculture and development of modern seed industry brought changes but more than 80 % of the pulses seed planted are still farmers saved. The seed replacement rate of most of pulses has not achieved the desired level and farmers are using their own saved seed resulting in low production as well as productivity of pulses.

Conservation Agriculture (CA) based resource conserving technologies (RCTs) like, zero-tillage, surface seeding, FIRB/BP, crop diversification and crop rotation provide tremendous opportunity for increasing pulses production by its area expansion as well as improvement in productivity due to timely crop establishment, better utilization of natural resources, more opportunity for system intensification/ diversification, saving in external inputs, reduction in cost of cultivation and increasing the input use efficiency (Abrol et al., 2005). Inclusion of pulses with appropriate RCTs options has a good opportunity for intensification /diversification

of the better utilization of rice fallows /flood prone/excess moisture areas. The value of pulses for sustainability of the production system is well recognized but the key issue is where and what extant to diversify rice–wheat systems, and with what crops and in which season.

After first green revolution the introduction of high-yielding verities of rice and wheat and improved irrigation facilities, area under these two crops has increased tremendously. Both the crops (Rice and Wheat) are more productive and relatively less susceptible to different biotic and abiotic stresses compared to pulse crops, it has replaced the legumes and other less productive crops such as millets, wherever any kind of irrigation infrastructure or farmers' economic conditions improvement took place. These factor led to increase in rice and wheat crop area by 30% and 92%, respectively in last 04 decades (37.6 million ha and 18.20 million ha for rice and wheat, respectively during 1970-71), whereas, the area under pulses (22.6 and 24.8 million ha in 1970 and 2011 respectively) remained almost constant and only a negligible increase of 2.2 million ha was recorded. Even this small increase in area of pulses was mainly ascribed to new marginal lands brought under cultivation or to the land not fit for rice or wheat cultivation resulted in stagnant production of pulses, of about 15-17 million t, whereas the production of rice and wheat increased manifold. The area and productivity under pulses viz., pigeon pea, chickpea and lentil suffered to a great extent with the expansion of RWCS in all the rice-wheat growing states. In the quest of rice-wheat cropping system scenario, and with the knowledge of the beneficial role of pulses in sustaining high productivity of RWCS, the present climate change situation of legumes in rice-wheat cropping system needs to be changed. Furthermore, inclusion of pulses in RWCS assumes a great significance in modern agriculture due to inadequate availability of organic sources of plant nutrients.

Constraints in Quality Seed Production of Pulses

Production of high-quality seed is fundamental pre-requisition for modern agriculture. Most of pulse crops are grown in each season from seeds, and seed quality can have a major component for harvesting potential crop yield. The major production constraints, availability of quality seed of improved varieties at right time and places have been a major constraint for enhancing production and productivity of pulses in India. The seed replacement rate (SRR) in pulses are very low i.e. 11.9 per cent in chickpea to 23.89 per cent in black gram at country level. This is primarily due to lack of suitable insect-pest and disease resistant verities. Out of 24.80 million ha, about 84% of the area is under rainfed/dryland conditions. Lack of fine tuned package of practices, highly susceptible to drought and water logged conditions, unorganized seed production programmes, poor production of breeder seed to foundation and certified seed pulses by the

state departments are some of hurdle in quality seed production. To ensure timely availability of quality seed, seed production system must be enhanced with introduction of contractual obligation component by involving seed grower associations, farmers, and NGO's besides SAU's, IIPR and State Seed Corporations to fulfillment of target of NFSM-pulses. Participation of seed growers in seed production should be encouraged by way of simplifying the registration under seed village schemes including 60,000 villages for seed production and follow seed certification procedures as per seed stansareds.

Technological Options for Inclusion of Pulses in RWCS

Technological options for RWCS are intercrops, catch crop, relay cropping and substitute crops. A large number of field experiments carried out under All India Coordinated Research Project on Cropping Systems in different agro-climatic regions have indicated that the beneficial effect of pulses for the production, system productivity, nutritional security, environmental health, profitability, resource use efficiency and soil fertility restoration of RWCS. Research evidences suggest that a large scope exists for inclusion of pulses in rice-wheat system as catch crop, intercrop, green fodder or as a green manure. Alternatively, in a long-term prospective, one of the cereal crops can also be substituted with a pulse crop which generally acts as a soil health restorer on account of its ability to fix atmospheric N and utilize soil nutrients and moisture from the lower strata of the soil through their tap root system, which in turn saves N requirement of succeeding crop (Singh, 2012) and produce quality seed as per farmers demand.

Pulses as intercrops: Short duration pulses such as black gram, green gram, and soybean are ideal intercrops to some extent in upland direct seeded rice. The scope of legume intercrop under rice-wheat cropping system further increases under water stress conditions or aberrant weather situation, as it not only increase total productivity of the system but also play an important role in economizing the use of resources, particularity N fertilizer besides providing food, nutritional security and quality seed production. However, the potential of pulses as intercrops for seed production in RWCS has not yet been fully exploited, but with advent of modern tools like bed planting, multi-crop seed drills, it may emerge one of the promising options for rice-wheat system sustainability.

Pulses as catch crops: The most feasible way of including pulses in RWCS without decreasing land area of these crops is to grow pulse as catch crop. In RWCS, medium duration rice varieties followed by wheat varieties suited for normal sowing or late sowing in north-eastern plain do not leave scope to grow legume between rice harvest and wheat sowing. However, the period between wheat harvesting and rice planting can be utilized for growing short duration (60-70 days) and extra short duration (45-50 days) summer legumes such as green gram. Experiment at Masodha, Varanasi (Singh et al.

2011) and Ludhiana indicated that inclusion of mung bean in RWCS enhances the total productivity and net returns as compared to RWCS alone. In other studies, the yield of rice in rice-wheat system generally remained higher when preceded by mung bean (Singh and Sharma, 2001). Incorporation of summer mung bean biomass to soil after picking the pods not only improves yields but also reduce the N fertilizer demand of succeeding rice crops by up to 25%.

Pulses as diversify/substitute crop: The substitution of rice or wheat largely depends on nature of stress increased in different agro-ecological situations. For instance, in Trans-Gangetic Plain (TGP), where water table depletion is serious concern, there is scope for substituting rice with short duration, low duty and deep rooted pulses which can extract soil moisture from deeper soil layers during dry spell like pigeon pea, black gram and cowpea (Singh et al. 2005; Yadav et al. 2003). Similarity in eastern part of India, where wheat productivity is generally low because of climatic constraints particularity higher thermal regimes, rice-wheat need to be substituted with short duration varieties of chickpea, lentil, urdbean and mungbean in rice fallows of eastern India (U.P., Jharkhand, Bihar and West Bengal) and coastal peninsula (A.P., Karnataka and Tamil Nadu). In *Tarai* region, the annual productivity in terms of rice equivalent yields, energy production and net return increased tremendously in rice-wheat system, when a green manure or maize+cowpea fodder crop was introduced during post-wheat summer season (Table 1). Diversifying wheat with chickpea was further advantageous. In double crop sequences involving cereal crops only, diversifying *kharif* or *rabi* cereal with a grain legume has shown promise. Raising a pulse crops such as short duration pigeon pea in rice-wheat cropping system can also mitigated the adverse effect of continuous puddling on the soil compaction. In other words, inclusion of pulses in RWCS may help in better crop establishment and root growth of wheat following rice, by way of reducing soil compaction.

Some Basic Requirement for Breeder Seed Production of Pulses

Mandal et al. (2010) suggested some basic and important guidelines for the seed production of pulses. Which are listed as under:

- The agency producing breeder seed requires nucleus seed of the varieties from the concerned breeder/Institute along with a list of specific characteristic/features of the variety.
- The nucleus seed is planted in a disease free, well prepared and homogeneous plot that should follow recommended isolation distance from other field having same crop. The planting should be done as per sowing time recommended.
- Planting is done with the required seed rate leaving sufficient space after each bed for easy monitoring of the field. The plot should be managed as per the recommended package of practices of cultivation.
- The breeder should visit the plot at regular intervals for rouging to rogue out off-type plants before flowering.

- Harvesting should be done at the proper maturity. Precautionary measures should be taken at the time of harvesting and threshing to avoid mechanical mixtures. The simultaneous threshing of the two varieties should be avoided.
- The seeds should be dried to 10% moisture level before storage, if required.
  Grow out test should be carried out as per the standard procedure, after taking samples from different lots to confirm the purity of the seed.
- The seed should be treated with insecticide to protect it from the store pests and be packed in properly labeled gunny bags.
- All the prescribed BSP Performa (except BSP I: allocation) should be sent to Project Coordinators, ADG (Seeds) ICAR; and Seed Division of DAC at the scheduled time so as to complete the process effectively and efficiently.

Isolation distance and some specific requirement during seed production of pulses:

Isolation distance ensures genetic purity of seed by keeping the seed production plot separate from other varieties to prevent cross pollination. As applied to seed production, isolation means the separation of a crop from all possible sources of contamination during the growing period. An isolation distance is needed where different varieties are being grown for seed production. The objective of maintaining isolation is to minimize out crossing in plants intended for seed production. If pollen from another variety fertilizes plants in a seed crop the varietal purity will decline. Isolation distance (Table 2) and some basic requirements (Table 3) for seed production of pulses are mentioned herein:

Table 1: Effect of legume inclusion on system productivity, energy production and economics at Pantnagar, India

Crop sequence	System productivity		Chemical energy equivalent (k cal * 10^{-4} ha^{-1})	Economics (₹ ha^{-1})	
	Rice equivalent yield (t ha^{-1})	Production efficiency		Gross return	Return over variable cost
Wheat-rice	10.3	28.28	3533	48302	32188
Chickpea-rice	10.8	29.79	3132	49203	35467
Wheat-*Sesbania* (green manure)-rice	11.2	30.75	3851	52715	34942
Wheat-maize+ cowpea (fodder)-rice	13.4	36.74	5051	61682	40793
Chickpea-maize+ cowpea (fodder)-rice	13.9	38.09	4865	62503	43992
CD 5%	0.5	6.64	333	3803	2955

Source: Singh and Sharma (2002)

Table 2: Isolation distance requirement for foundation and certified seed production of pulses

Crop	Minimum Isolation Distance (m)		Remarks
	Foundation Seed	Certified Seed	
Black-gram, Green gram, Rice bean, Field pea	20	10	Other varieties & the same variety not conforming to varietal purity
Cowpea, Rajmash, French Bean, Lentil	50	25	- do -
Pigeon-pea (Arhar)	50	25	- do -

Table 3: Specific requirements for seed production of pulse crops

	Maximum permitted (%)	
Factors	Foundation seed	Certified seed
Black gram, Bengal gram, Lentil, Pea, Pigeon pea		
Off type plants	0.10	0.20
Green gram, Cowpea, Rajmash		
Off type plants	0.10	0.20
Plants affected by seed borne diseases	0.10	0.20

Conclusion

Intensively cultivated RWCS have started exhibiting signs of stress, inclusion of pulses may prove a better option for sustaining food and nutritional security for ever increasing population of India. Quality seed production of pulses is prime goal for fulfillment of pulse demand of country besides increasing system productivity in terms of soil fertility restoration and economic gain to farmers. Rice and wheat are staple food of million populations, and the IGP is one of the major important areas (about 10 million ha area under RWCS) contributing towards total food grain production in India, inclusion of pulses as catch crop, intercrops, and diversification and/or substitute of rice with pulses may be important areas for production of quality seed of these crops. Therefore, inclusions of pulses in the rice-wheat rotation also minimize noxious weed population, sustained system productivity and restore soil health.

References

Abrol IP, Gupta RK and Malik RK. 2005. Conservation Agriculture Status and Prospects. Centre for Advancement of Sustainable Agriculture, New Delhi.

Anonymous. 2012. *Economic survey*. Govt. of India, Ministry of Finance, pp. A 17-19.

Mandal AB, Sinha AK and Natarajan S. 2010. Nucleus and breeder seed production manual. Directorate of seed research (DSR) Kushmaur, Mau- 275101 (UP). PP 84-85.

Singh UP, Singh Y, Singh RG and Gupta RK. 2011. Opportunities for increasing food legume production through Conservation Agriculture based resource conserving technologies in rice wheat System. http://aciar.gov.au/files/node/14068/opportunities_for_increasing_food_legume_productio_14400.pdf.

Singh VK. 2012. Legume inclusion under cropping system for conserving resources. Lecture note in Winter School on "System Based Conservation Agriculture for Sustained Productivity and Soil Health" Oct 3 to 23, 2012, PDFSR, Modipuram, page no. 47-52.

Singh VK and Sharma BB. 2001. Productivity of rice as influenced by crop diversification in wheat-rice cropping system on Mollisols of foothills of Himalayas. *Indian Journal of Agricultural Sciences* **71** (1): 5-8.

Singh VK and Sharma BB. 2002. Economic evaluation of rice based cropping systems in foothills of Himalayas. *Indian Journal of Agronomy* **47** (1): 12-19.

Singh VK, Dwivedi BS, Shukla AK, Chauhan YS and Yadav RL. 2005. Diversification of rice with pigeonpea

in a rice-wheat cropping system on a Typic Ustochrept: effect on soil fertility, yield and nutrient use efficiency. *Field Crops Research* 92: 85-105.

Yadav RL, Singh VK, Dwivedi BS and Shukla AK. 2003. Wheat productivity and N use-efficiency as influenced by inclusion of cowpea as a grain legume in rice wheat system. *Journal of Agricultural Science*, Cambridge **141**: 213-220.