Five Best Technologies for Up-scaling .

Technology-1

1. **Title: High oil and grain yield in Soybean through Sulphur Nutrition.**
2. **Brief background:** Modern agriculture has become highly efficient and has contributed greatly to national economic growth. Madhya Pradesh is generally called "The Soybean State" of India contributing more than 70% in terms of area and 64% of the total production (Joshi 2003). The soil type is pre-dominantly black-cotton soils which are low in nitrogen, low to medium in phosphorus and medium to high in potassium content with alkaline in nature. The area has been identified under >70% deficient in Sulphur. Sulphur deficiency is increasing throughout the world as a result of less use of Sulphur (S) containing and maximum utilization of high analysis fertilizers, intensive cultivation, increased irrigation, high-yielding varieties, and S-free fungicides. The major crop of the kharif season is soybean occupying an area of 4, 16,000 ha which amounts to 94 % of the total kharif season. In the wake of acute injudicious use of fertilizers as well as poor awareness towards integrated nutrient management system in Vertisols of Ujjain, application of Sulphur has became very important input for augmenting the production and productivity of soybean in the district. This work was initiated by KVK Ujjian through OFT and FLD since 2007 and is in continuation through recommendations in package of practices.
3. **Scientific rationale / justification:** Sulphur is an essential nutrient element for plant as well as animal kingdom. It often accumulates in areas with volcanic activity, and mostly found in organic form in soils. Though S is a secondary nutrient element, its uptake is 9-15% of N uptake and similar to that of P uptake. Intensification of agriculture with high yielding varieties and multiple cropping coupled with use of high analysis sulphur free fertilizers along with restricted or no use of organic manures have accrued in depletion of soil sulphur reserve. The importance of sulphur in oilseed production is obvious because of the following reasons-

- Required for the synthesis of sulphur containing amino acids methionine (21%), cysteine (26%) and cystine (27%), which are essential components of protein. Approximately 90% of plant sulphur is present in these amino acids (Tandon and Messick, 2002). Also needed for the synthesis of metabolites such as coenzyme A, biotin, thiamin or vitamin B_1 and glutathione.
- Involved in the formation of chlorophyll, glucosides and glucosinolates (mustard oils), activation of enzymes and sulphydryl (-SH) linkages that are the source of pungency in oils.
- Increases root growth and stimulate seed formation.

4. **Horizontal spread and adoption level in the district.**

No. of Village	562
Area (ha.)	2,25,000 ha
No. of Beneficiary	84000
Level of adoption (%)	50

5. **Production potential, productivity and Economic analysis.** (Based on pool analysis of 10 years)

Technology Assessed / Refined	Production potential kg /ha	Production per unit	Net Return (Profit) in Rs. / unit over farmers practice	Incremental B:C Ratio
Farmer's practice	2500 to 3000	1390	10150	**1:3.26**
Technology assessed RDF (20:60:40)+ 20 kg sulphur		1910		

Soybean yield increased 37 % by the application of 20 Kg Sulphur/ha, it may be due to much more responsive soil in favour of sulphur nutrition. Besides this, data also revealed that there was increase of 5% in test weight and number of pods per plant. The incremental B: C ratio was 1:3.26.

6. **Increase in Income:**

   At the present level of market price and MSP the farm families who have adopted this technology are harvesting on an average 30 percent more yield over the district average. Thus per hectare increase in income is approximately 37 percent.

7. **Future strategies for further expansion and limitation:**

   Through frontline extension and convergence with ATMA.

   Making available Gypsum at low cost to farmers and scrapping Gypsum from the list of fertilizers.

Action Photographs

References:

Dixit, A. K.; Arvind Saxena; Tomar, D. S.; Kaushik, S. K.; Rekha Tiwari; Lalit Jain; Ghazala Khan Importance of sulphur nutrition on productivity of soybean in vertisols of M.P. Indian Journal of Fertilisers 2009 Vol.5 No.10 pp.61-63 .

Joshi, O.P 2003.Future perspectives of soybean in India. Soybean research (1):29-42

Malik, R.S 1999. Crops in India need sulphur. *Indian farming: 11-13.*

Scherer H.W. (2009): Sulfur in soils. Journal of Plant Nutrition and Soil Science, 172: 326–335.

Tandon H.L. S. and Messick D. L. (2002): Practical Sulphur Guide. The Sulphur Institute, Washington, D.C. Pp. 20.

Technology-2

1. **Title: Novel Planting Technique For Higher Production In Poorly Drained Heavy Soils: FIRBS**
2. **Brief background:** Research into permanent bed systems started at CIMMYT, Mexico, is showing encouraging results. An additional advantage of bed planting becomes apparent when beds are "permanent", that is, when they are maintained over the medium term and not broken down for every crop. Making of permanent beds can help overcome constraints of resource depletion and pollution of existing systems. This has the potential of reducing cost of rice-wheat cultivation by 20%-25% over conventional methods. In this system, wheat is harvested and straw is left or burnt. The beds are reshaped by passing a shovel down the furrows. The next crop (soybean, maize, sunflower, cotton, etc.) can then be planted into the stubble in the same bed. The advantages of this system are reduced costs, erosion control, reduced soil compaction and, perhaps, better soil physical structure over time. Change over from growing crops in flat to ridge-furrow system of planting crops on raised bed alters the crop geometry and land configuration, offers more effective control over irrigation and drainage as well as their impacts on transport and transformations of nutrients, and rainwater management during the monsoon season.
3. **Scientific rationale / justification:** In furrow irrigated raised bed (FIRB) system, water moves horizontally from the furrows into the beds (subbing) and is pulled upwards in the bed towards the soil surface by capillarity, evaporation and transpiration, and downwards largely by gravity. In determining the dimensions of the beds, factors such as spacing between tractor tyres, soil types, rainfall and groundwater conditions, salinity and irrigation water quality and requirements of crops grown in rotation are of prime importance.

   This system is often considered more appropriate for growing high value crops that are more sensitive to temporary water logging stress. Farmers often raise crops such as cotton, maize-soybean and wheat on the raised beds. However, the practice of growing rice, the major water-using crop in rice-wheat systems, on narrow raised beds was introduced only very recently in Madhya Pradesh to reduce water use, conserve rainwater and improve system productivity.
4. **Horizontal spread and adoption level in the district :**

No. of Village	675
Area (ha.)	45,000
No. of Beneficiary	5170
Level of adoption (%)	11.4

5. **Production potential, productivity and Economic analysis.**
   Conservation furrows after every two / three rows helped in higher availability of water to the crops resulting in increase in yield by 20.8 % and higher moisture in the soil at harvest in 15-30 cm soil depth.

Soybean Yield (kg/ha)		Net Return (Rs/ha)		BC Ratio	
FP	RP	FP	RP	FP	RP
1250	1510	14600	18480	1.7	2.2

6. **Increase in Income:**

At the present level of market price and MSP the farm families who have adopted this technology are harvesting on an average 20 percent more yield over the district average. Thus per hectare increase in income is approximately 26 percent.

7. **Future strategies for further expansion and limitation:**

Any technology for its wider dissemination should fit in farmer's own scheme of things. It should adapt to his agro-ecological matrix. So, instead of testing the technology in smaller plots at research station, farmer participatory approach was adopted with twin methodologies :

1. Those farmers who are already improved seed drills in one or the other way were encouraged to purchase the implement available on subsidy from state government to have the soybean,chickpea and wheat under furrow irrigated raised bed system (FIRBS).
2. Those farmers who are resource poor were introduced with the custom hiring centers by making small groups so that at one operation 50 to 75 ha area is sown in a particular village and the expenditure is reduced to a considerable extent..

Action Photographs

8. **REFERENCES:**

Hobbs, Peter R. and Mehla, R. S. 2003. The problem of late planting in wheat. In : Addressing Resource Conservation Issues in Rice-Wheat Systems of South Asia - A Resource

Book. Rice-Wheat Consortium for the Indo-Gangetic Plains - International Maize and Wheat Improvement Centre, New Delhi, India. pp. 91-94.

Singh, Samar; Yadav, Ashok; Malik, R. K. and Singh, Harpal. 2002. Furrow-irrigated raised bed planting system – a resource conservation technology for increasing wheat productivity in rice wheat sequence. International Workshop Proceedings on 'Herbicide Resistance Management and ZeroTillage in Rice-Wheat Cropping System' – March 4-6 at CCS HAU, Hisar. pp. 198-200.

Technology-3

1. **Title: A new Durum wheat variety HI 8663 (Poshan) boon for wheat farming under terminal heat stress conditions.**
2. **Brief background:** Recently, Inter Governmental Panel on Climate Change (IPCC) report and several other studies indicate a probability of 10-40% loss in crop production in India and other countries of South Asia with increases in temperature by 2080-2100 and decrease in irrigation water. India could lose 4-5 million tons wheat production with every rise of 1^0 C temperature throughout the growing period even after considering carbon fertilization (but no adaptation benefits). Drought is one of the most common environmental stresses that affect growth and development of plants. Drought continues to be an important challenge to agricultural researchers and plant breeders. It is assumed that by the year 2025, around 1.8 billion people will face absolute water shortage and 65% of the world's population will live under water-stressed environments. Tolerance to water stress is a complicated parameter in which crops' performance can be influenced by several characteristics. Hence, terminal heat tolerant wheat cultivar is the need of hour whereas most of the farmers(45-55% of wheat growing areas) cultivating traditional varieties without drought tolerance in nature. Now, the soy state is turning over a new leaf adopting wheat variety(Poshan). The Madhya Pradesh has earned a name for its high wheat production and quality. Farmers of Madhya Pradesh are moving towards scientific farming with the help of KVK. They have slowly scripted a new success story by producing the best wheat in India. The lustrous, golden grain commands premium price. Being re-christened golden or premium wheat in wholesale and retail markets of Mumbai, Pune, Ahmadabad and Hyderabad or simply, MP wheat in major North Indian markets like Delhi.
3. **Scientific rationale / justification:** HI 8663 (Poshan) is a novel genotype characterized by excellent grain quality, high and stable yield. It can serve as a naturally bi-fortified food and can be used for "dual purpose", i.e., both for 'nutritive chapatti' and semolina, required for fast food preparation, because of its high β-carotene, high hectoliter weight, high SDS sedimentation value, higher protein content, high levels of micronutrients, lowest mottling (yellow berry incidence) and having better overall acceptability (7.0) for pasta. This variety was notified in May 2008 for cultivation under high fertility irrigated and timely sown conditions. It is a widely adapted and high yielding variety, showing 1.4% to 28.4% yield superiority over checks MACS 2846, NIDW 295 and GW 1189. HI 8663 has shown good adaptation more number of tillers per sq. m, as compared to checks. It combines early maturity, tolerance to terminal heat stress. It ensures stability in wheat production and better yield even under deficient irrigation availability in Central Zone.
4. **Horizontal spread and adoption level in the district :**

No. of Village	217
Area (ha.)	48900
No. of Beneficiary	9780
Level of adoption (%)	31.9

5. **Production potential, productivity and Economic analysis.**
Under changed climatic scenario, wheat variety Poshan showed 38.8% yield superiority over farmers practice along with better economics in favours of farming.

Yield (kg/ha)		Net Return (Rs/ha)		BC Ratio	
FP	RP	FP	RP	FP	RP
4635	6440	55562	78411	4.15	5.32

6. **Increase in Income:**
At the present level of market price and MSP the farm families who have adopted this technology are harvesting on an average >35 percent more yield over the district average. Thus per hectare increase in income(Rs 22849/-) is approximately 40 percent.

7. **Future strategies for further expansion and limitation:**
Any technology for its wider dissemination should fit in farmer's own scheme of things. It should adapt to his agro-ecological matrix. So, instead of testing the technology in smaller plots at research station, farmer participatory approach was adopted with following approach:
    1. Availability of a good quality seed of Poshan variety should be ensured for timely sowing by farmers.
    2. There should be expansion the direct linkages between farmers and purchaser(Industrialist) for better market price.

Action Photographs

Technology-4

1. **Title: Increase the farm Income through replacement of desi type with kabuti type chickpea. or**
   A key of fetching high market price in chickpea: Grow Kabuli chickpea.

2. **Brief background:**

   The chickpea, also known as a garbanzo bean, ceci bean, sanagalu, chana, and Bengal gram has an interesting fact behind its name. It's called Chickpea because it looks like baby chick. This pulse is estimated to be at least 7,500 years old and was originally cultivated at Mesopotamia and The eastern Mediterranean. Currently, it is grown in India, Middle East and various parts of Africa. This highly nutritious pulse is ranked third in the important list of the food legumes that are cultivated throughout the world.

   India is the largest producer of Chickpeas and approx 80-90% supply of Chickpeas to the world is from India. Chickpeas can be grown on standing or tilted stubble and fallow. Kabuli chickpeas are planted when soil temperature at a depth of 2 inches to 3 inches reaches at least 10ºC while Desi types are planted in soil that is 4 ºC or above to reduce soil-born diseases. It is cultivated on Fertile, sandy & loam soil in cool season in various parts of India provide perfect condition for Chickpea growth. Indian weather conditions of 21 ºC to 26 ºC daytime temperatures and 17 ºC to 21 ºC night temperatures also favor this crop. Chickpeas have deep tap root system so they can endure drought conditions by extracting water from deeper soil. Maturing time require for Chickpeas is 120 days. Chickpeas are one of the most popular vegetarian foods; this can be prepared in varieties of ways for 'n' number of dishes. Unripe chickpeas can be eaten raw while mature chickpeas cooked and eaten in salad. This can also cooked and ground into a paste (hummus). Chole-bhature is the famous Indian cuisine made from Kabuli Chickpeas. Split chickpeas are used to make dal.

   Chickpeas have mainly two types i.e. Desi and Kabuli. Kabuli Chana is especially popular in North India. Kabuli Chickpeas is mainly cultivated in Southern Europe, Northern Africa, Afghanistan, Pakistan and Chile, also introduced during the 18th century to India.Farmers of the district growing desi chickpea at large scale on an area of more than 145000 ha but farmers get low income during marketing at mandi as compared to kabuli chickpea. the soil type and topography of the area fits for kabuli farming along with fetching higher prices during marketing attracting the farmers for kabuli cultivation.

   Scientific rationale / justification: There are mainly two types of Chickpeas: Desi and Kabuli. This classification is based on seed size, colour, thickness and shape of the seed coat. **Desi Chickpeas** are smaller, angular seeds with thick seed coats that range in colour from light tan and speckled to solid black. Desi Chickpeas are the most widely grown under dry land. **Kabuli chickpeas** have larger seeds with paper thin seed coats that range in colour from white to pale cream to tan. Due to soft in seed coat kabuli chickpea demands more in urban areas of Nation as well as abroad. Kabuli chickpea marketed at higher prices in mandi results in more return to farmers

from the same crop over desi type. There is an another parameter i.e. test weight reflects significantly. The test weight of kabuli types ranges from 53g to 58g whereas desi types ranges from 30 to 36g. The productivity of both types not differs significantly whereas economics shows dissimilarity creates interest among farmers.

8. Horizontal spread and adoption level in the district :

No. of Village	147
Area (ha.)	65000
No. of Beneficiary	32000
Level of adoption (%)	42

9. **Production potential, productivity and Economic analysis.**

Under low water availability area kabuli chickpea showed 16.7% yield superiority over farmer,s practice i.e. desi chickpea along with better economics step towards strengthening of chickpea farming.

Yield (kg/ha)		Net Return (Rs/ha)		BC Ratio	
FP	RP	FP	RP	FP	RP
1680	1960	38800	74900	1.94	2.98

10. Increase in Income:

At the present level of market price and MSP the farm families who have adopted this technology are harvesting on an average >60 percent more yield over the district average. Thus per hectare increase in income(Rs 36100/-) is approximately 90 percent.

11. Future strategies for further expansion and limitation:

Any technology for its wider dissemination requires suitable climatic requirement as well as a good B:C ratio. The ensure seed availability of good quality seed at the time of sowing is another need. Kabuli cultivation can't successful in field those infected with fungal mycilliae. Kabuli chickpea cultivation restricted in the area where blown of cold waves is a regular phenomenon.

Action Photographs

Chickpea Variety RVSKG-102

Chickpea Variety Phule G-517

Chickpea JKG-3

FLD on Chickpea variety Kripa

Technology-5

1. **Title: High Quality Potato Chipps variety Kufri Chipsona-3 with Defect free Tubers.**
2. **Brief background:** Indian potato (*Solanum tuberosum* L.) processing industry has emerged fast due to economic liberalization coupled with growing urbanization, expanding market options and development of indigenous processing varieties. India's first potato processing varieties 'Kufri Chipsona-1' and 'Kufri Chipsona-2' were developed in 1998, followed by an improved processing variety 'Kufri Chipsona-3' in 2005 for the Indian plains. Currently about 4% of total potato produce is being processed in organized and unorganized sector. Potato processing industry mainly comprises 4 segments: potato chips, French fries, potato flakes/powder and other processed products. However, potato chips still continue to be the most popular processed product. The major challenge facing the industries lies in arranging round the year supply of processing varieties at reasonable price for their uninterrupted operation.
3. **Scientific rationale / justification:**
   Kufri Chipsona-3 is a medium maturing, late blight resistant potato variety with round oval tubers, white smooth skin and cream/pale yellow flesh. The variety is meant for processing, especially chip making, and is an improvement over the existing varieties Kufri Chipsona-1 and Kufri Chipsona-2. The total and process grade tuber yields of Kufri Chipsona-3 are higher than those of Kufri Chipsona-1 and Kufri Chipsona-2. The total tuber yields are higher than even the popular table variety Kufri Bahar. Kufri Chipsona-3 yields excellent defect free tubers. The chemical maturity of its tubers occurs at 110 days. The tubers have low reducing sugars (< 50 mg/100 g fresh wt) at harvest and even after six months of storage at 10-12oC. The dry matter content of its tubers is > 21%. This variety can be grown in the main season over entire North-western and North- central Indian plain. The availability of these varieties and standardization of storage techniques for processing potatoes at 10–12°C with sprout suppressant isopropyl N-(3-chlorophenyl) carbamate have revolutionized the processing scenario within a short span of 10 years**.**
4. **Horizontal spread and adoption level in the district.**

No. of Village	93
Area (ha.)	5500
No. of Beneficiary	6500
Level of adoption (%)	19.5

5. **Production potential, productivity and Economic analysis.**

Potato Yield (kg/ha)		Net Return (Rs/ha)		BC Ratio	
FP	**RP**	**FP**	**RP**	**FP**	**RP**
16500	21000	26982	54213	1.6	2.1

Yielded 27.3 % more than existing varieties apart from fetching 33 % higher price in the market. Ideal for contract farming in AEZ.

6. **Increase in Income:**
   At the present level of market price the farm families who have adopted this technology are harvesting on an average 27 percent more yield over the district average. Thus per hectare increase in income is approximately 33 percent.
7. **Future strategies for further expansion and limitation:**
   a) Lack of availability of quality seed. As of now there is no seed chain. Farmers are using the food grade tubers from cold storage as seed leading to severe disease problems.

Action Photographs

References:

Ezekiel, R., B. Singh, M.L. Sharma, I.D. Garg and S.M. Paul Khurana. 2004. Relationship between weight loss and periderm thickness in potatoes stored at different temperatures. Potato J. 31: 135-40.

Gaur, P.C., S.K. Pandey, S.V. Singh, Devendra Kumar, R.S. Marwaha and Dinesh Kumar. 1998. Kufri Chipsona-1: A potato variety for processing. J. Indian Potato Assoc. 25: 113-18.

Gaur, P.C., S.K. Pandey, S.V. Singh, R. S. Marwaha, Devendra Kumar and Dinesh Kumar. 1999. Kufri Chipsona-2: A new high dry matter potato variety for chipping. Current Science 76: 722-24.

Mottram, D. S., B.L. Wedzicha, A. T. Dodson. 2002. Acrylamide is formed in the Maillard reaction.Nature 419: 448-49.

Sowokinos J. R. 1978. Relationship of harvest sucrose content in processing maturity and storage life of potatoes. Amer. Potato J. 55: 333-45