STUDY ON ASSESSMENT OF CAUSES OF OUTBREAK OF YMV AND ESTIMATION OF YIELD LOSSES IN SOYBEAN DURING KHARIF – 2015 IN MADHYA PRADESH

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1. Background

Soybean has a prominent place among the important seed legume of the world and pronounced as miracle bean. It contains about 40 per cent protein, 20 % oil with balanced essential amino acids, rich in poly-unsaturated fatty acids, specially omega 6 and omega 3 fatty acids, 6-7% minerals, 5-6 % crude fibre and 17-19 % carbohydrates **(Chauhan and Joshi, 2005).** Soybean contributes 25% of the global vegetable oil production and about two thirds of the world's protein concentrate for livestock, poultry and fish.

India occupies foremost position in global soybean scenario, accounting for about 11 per cent of area and 4.3 per cent production **(FAO, 2013).** Soybean has changed the economic scenario of farmers in Madhya Pradesh, Maharashtra and part of Rajasthan. An ever highest production of about 14.67 million tonnes was recorded with a coverage of 10.84 million ha during Kharif 2012, which attributed to highest area coverage of about >12 million ha during Kharif 2013. However, production was declined due to untimely heavy rains at the time of maturity during Kharif – 2013. Similarly, area coverage and production of soybean suffered continuously during Kharif 2014 and Kharif 2015 due to delayed / deficit rainfall, infestation of YMV and long dry spell at seed filling stage. MP contributes >50% both of area and production of soybean in India. Mainly because of short duration (90-105 days) with high net return, it has been widely accepted by the farmers. Approximately, 45 % of total cropped area of M.P. is occupied by soybean during Kharif season. Soybean production was more drastically declined during Kharif- 2015 due to excess rains at vegetative phase, long dry spell at seed filling stage and infestation of YMV and other insect pest.

The Yellow Mosaic Virus (YMV) disease, caused by Gemini virus and transmitted by white fly (*Bemisia tabacci*) is the most important disease of soybean. Infestation of YMV could be visualised in the form of yellow spots, which are either scattered or produces in indefinite bands along the major veins of soybean leaves.

Infestation of Yellow Mosaic in Soybean

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Some time severe mottling and crinkling of leaves are also seen. Leaves of severely infected plants become yellow when they are young. Affected plants bear less flower and pods. Besides India, it is prevalent in Sri Lanka, Bangladesh, Pakistan and Thailand. The economic loss caused by YMV disease is 30-50%; however, it may go up to as high as 80% in extreme cases (**Nene, 1972).** It was first observed in North India in early 1970s but was never seen in alarming proportions in Central India. Its expansion towards central India, a soybean bowl, may be fatal to the soybean industry in general and to the SMF soybean growers in particular. Major soybean varieties grown in the central India have been found susceptible to YMV. YMV is transmitted by white fly; therefore, control of this disease is indirectly related to the control of its vector. Its chemical or cultural control has not been found to be economical and environmental friendly. Only deployment of genetic resistance has been proved the way of its control or management.

2. Scope of the Study

Soybean cultivation, which was introduced as an oilseed crops in late 60s, has now occupied first position both in terms of area and production of oilseeds and 2nd position in terms of vegetable oil. There have been sporadic incidence of YMV in the past as well but severe infestation of YMV observed during Kharif-2015, may be a threat for soybean cultivation in the state. The State Department of Agriculture has reported yield losses up to 40% in soybean. Accordingly, a study has been conducted on causes of outbreak of YMV and estimation of yield losses in soybean during Kharif-2015.

3. Objectives

Study aims to make a field assessment of causes of outbreak of YMV and estimation of yield losses in soybean during Kharif-2015. Since the crop had already been harvested, findings are based on the feedback of the soybean growing farmers and secondary data. The major objectives of the study were as under:

- To find out the causes of outbreak of YMV.
- To determine the yield loss in soybean during 2015.
- To find out the reasons of yield loss in soybean during 2015.
- To examine the extent of adoption of recommended technology of soybean production/ knowledge level of farmers.
- To understand farmers perception about YMV.

4. Methodology of Study

The detail methodological framework is presented in this section. The whole procedure was divided into sampling procedure and collection of primary and secondary information. Each main part again described under its sub-sections to understand the procedure for ultimate selection of soybean growers in the study area. The sampling procedure to consider the district, block, villages and respondents is indicated under the following sub-sections.

4.1 Selection of districts

Three districts *viz*., Chhindwada, Ujjain and Betul of Madhya Pradesh were selected for the study in consultation with the Department of Agriculture, Cooperation and Farmers Welfare, GoI and State Department of Agriculture, where yield losses due to YMV were reported by the state.

4. 2. Selection of blocks

Two blocks in each district(total 6 blocks) *viz.*, Mohkhed and Chhindwara blocks in Chhindwada district, Mahidpur and Tarana blocks in Ujjain District and Betul and Amla blocks in Betul district of Madhya Pradesh were identified for the study. The selections of these blocks were made in consultation with the State Department of Agriculture of the concerned districts.

4.3 Selection of villages

Two villages were selected in each block (12 villages) and 10 soybean growing farmers from each village, totalling to 120 farmers were selected for the study.

Table 1: Details of blocks, villages and soybean growing farmers

S. No.	District	Selected Blocks	No. of Selected Villages	No. of selected farmers
1.	Chhindwara	Chhindwara	02	20
		Mohkhed	02	20
Sub-total		**02**	**04**	**40**
2.	Ujjain	Mahidpur	02	20
		Tarana	02	20
Sub-total		**02**	**04**	**40**
3.	Betul	Betul	02	20
		Amla	02	20
Sub-total		**02**	**04**	**40**
Grand-Total		**06**	**12**	**120**

4.4 Data Collection

Broadly the data required for the study has been divided in to two parts i.e. primary and secondary information.

4.5 Primary Data

The primary information has been collected by direct interview with soybean growers of selected villages/ blocks/districts. Structured well designed, schedule and questionnaire were used for the purpose. The information collected from soybean growers consist variety of soybean sown by the farmer, date of sowing , date of infestation of YMV observed by farmer, stage of crop when YMV occurred, degree of infestation (Heavy/ moderate/ low), spread of YMV(whether uniform or sporadic), effect of YMV on plant growth (stunted/excess growth), soybean yield recorded in heavily infested plots and plot without infestation, frequency of YMV infestation during last 10 years, Major insect / pest observed other than YMV. The farmers

feedback about the causes of outbreak of YMV and technology aspects is given in ***Annexure – I, (a), (b), (c) and (d) respectively.***

4.6 Secondary data

The secondary data has been collected from state Department of Agriculture, Government of Madhya Pradesh at state and district level. The land use statistics of the sample districts is given in **Table 2.**

Table 2: Land use statistics of selected districts

(Area: Lakh ha)

Particulars	**Chhindwara**	**Ujjain**	**Betul**
	Area	**Area**	**Area**
Geographical Area	11.84	6.10	10.08
Net Sown Area	5.11	5.01	4.31
Total Cropped Area	7.52	8.82	5.66
Double Cropped Area	2.41 (32.05%)	3.81 (43.20%)	1.77 (31.27%)
Net Irrigated Area	2.20 (43.05%)	3.48 (69.46%)	1.65 (38.28%)
Forest Cover	1.88	0.03	2.83
Cropping Intensity (%)	140	176	137
Average Rainfall (mm)	1000.00	906.2	1083.9
Major Crops of the district			
Kharif crops	Soybean, Maize, Cotton Arhar& Paddy	Soybean & Maize	Soybean, Maize ,Paddy, Tur
Rabi crops	Wheat , Gram	Wheat & Gram	Gram, Wheat

Source: State Department of Agriculture, Chhindwara/Ujjain/Betul

The details of secondary data of weekly temperature & rainfall from June to September for last 05 years in respect of Chhindwara, Ujjain and Betul districts is given in **Annexure-II ,** ***(a), (b) and (c) respectively.*** Area, production and productivity of Kharif & Rabi crops during last five years of Chhindwara Ujjain and Betul districts is given in **Annexure-III ,** ***(a), (b) and (c) respectively.***

4.7 Analysis

The simple analytical tools used in study i.e. mean, average, absolute & relative change.

4.8 Limitation of the study

Some of the following limitations may or may not affect the findings of the study up to some extent. These limitations are as under:

- The whole study is based on the survey conducted after the harvest of the crop and the information provided by the farmers, usually lowers side has been taken in to consideration.

- The study could not get the benefit of the experience/response of the major stake holders from ICAR (ICAR-DSR, Indore) and SAUs (JNKVV, Jabalpur & RVSKVV, Gwalior).
- The inferences have been drawn on the basis of past average yield of soybean of concerned districts.

5. Results and discussion

The results and discussion are based on the demographic features of the soybean growers, cost on resource economy, objective-wise analysis are described as under:

5.1. General demographic features of sample farmers

The general characteristics of the sample households given in **Table- 3** indicates 22.50%, 27.50%, 25.83% and 24.17% share of marginal, small, medium and large farmers in Chhindwara, Ujjain and Betul districts of Madhya Pradesh respectively. The average per farm total cultivated area is observed 3.81 ha, 4.20 ha and 4.40 ha in Chhindwara, Ujjain and Betul districts respectively along with 4.14 ha as an overall average. An average area of each selected farmers under soybean is estimated as 2.60 ha, 3.00 ha, and 2.90 ha in the sample districts of Chhindwara, Ujjain and Betul respectively with an overall average of 2.83 ha. This indicates that about 75% of total cultivable area is used for soybean cultivation in the sample districts. An average area of 60% of the farmers holding is under assured irrigation.

Table 3: Demographic features of soybean growers of sampled districts

S No	Particulars	**Chhindwara**	**Ujjain**	**Betul**	**Overall**
A. Number of respondents					
(a)	Marginal	09	11	07	27 (22.50)
(b)	Small	11	09	13	33 (27.50)
(c)	Medium	07	11	13	31 (25.83)
(d)	Large	13	09	07	29 (24.17)
Total Number of Farmers		**40**	**40**	**40**	**120 (100)**
B. Average land classification (in ha)					
1.Land Holding		3.81	4.20	4.40	4.14
2. Net Cultivable area		3.20	4.00	4.25	3.82
3. Area under soybean		2.60	3.00	2.90	2.83
4.Irrigated area		2.60	2.30	2.58	2.49
5.Un -irrigated area		1.21	1.90	1.82	1.64
Percentage irrigated area of land holding		**68.00**	**55.00**	**59.00**	**60.00**
1.Canal		00	06	05	**11 (6.51)**
2.Tubewell		12	20	22	**54 (31.95)**
3. Wells		26	19	22	**67 (39.64)**

4.Tank	15	10	12	**37 (21.89)**
Irrigation from diff. sources	**53**	**55**	**61**	

Note: Figures in the parentheses indicate the percentage to total numbers.

5.2. Causes of outbreak of yellow mosaic disease and yield losses in soybean

Yellow mosaic disease (YMD) is major constraint in yield improvement in soybean, mungbean and urdbean. The aetiological virus causing YMD is begomovirus of the family Geminiviridae. This virus is transmitted by whitefly *Bemisia tabaci,* a sucking pest. The normal sowing time for soybean is 15th June to 15th July. The farmer feedback about the causes of outbreak of YMV given in Annexure-1(a) and ***Annexure – 1 (b)*** indicates maximum infestation of YMV at the stage of 25-50 day after sowing (DAS). The same period also witnessed heavy rainfall between mid of July to mid of August in sample districts. Heavy rains also affected the inter-culture operations leading to heavy infestation of weeds. Hot and humid weather coupled with excess growth of crops and also weeds provided a congenial environment for faster multiplication of white fly and other insect and pest in soybean. Some farmers also reported that the field where summer moong was taken prior to soybean also contributed in increased infestation of white fly and pest complex. Lack of effective system of "Pest Surveillance" also contributed in severe infestation of YMV in the sample district. The farmers who have used ridge-furrow or BBF had less infestation of white fly.

Long dry spells from last week of June to first fortnight of July, 2015 and further second fortnight of August to September, 2015 and uneven dispersal of rainfall in the Kharif, 2015 has severely affected the productivity of soybean. Lack of awareness among farmers about the adoption of recommended doses of pesticides and their timely application was also recorded.

5.3 Estimation of yield losses due to YMV infestation at sample districts

Based on the objective of the study, farmers/villages/blocks/districts with heavy infestation of YMV were selected. Actual yield of soybean obtained by the farmers from YMV infested plot at sampled farms presented in **Table 4**. The actual yield of soybean at farmer's field in the sample districts were estimated to be 1.38 Qtl. /ha, 1.97 Qtl./ha and 1.08 Qtl./ha at in Kharif, 2015 as against the normal district average (5 years) yield (DAY) of 16.95 Qtl./ha, 12.59 Qtl./ha and 10.01 Qtl.//ha and DAY of 8 qtl./ha, 6.37 qtl./ha and 1.67 qtl. / ha of Kharif 2015 in districts Chhindwara, Ujjain and Betul respectively. This indicates an average yield reduction of 89 %, and 72% against the normal district average (5 years) yield and Kharif – 2015 respectively. Since, 60% of land holding of sample farmers is covered under irrigation, chances of damage due to long dry spell are limited. Therefore, the higher yield losses in soybean in the sample districts may be attributed to multiple factors including higher vegetative growth with more plant population, infestation of YMV, other insect pest and long dry spell.

Table: 4 Actual yield received by the farmers at soybean YMV infested field

(Yield: Quintal/ha)

S. No.	Sampled Districts	Actual Yield at YMV infested plot	Normal District Average Yield* (DAY)	DAY Kharif – 2015	% Yield loss	
					Over Normal DAY (5 yrs. Avg.)	Over DAY (Kharif - 2015)
1	Chhindwara	1.38	16.95	8.00	92	83
2	Ujjain	1.97	12.59	6.37	84	69
3	Betul	1.08	10.01	1.67	89	35
Overall Average		**1.48**	**13.18**	**5.35**	**89**	**72**

* Normal District average yield: five year average (2010-11 to 2014-15), SDA, MP

5.4 Variety-wise yield losses in soybean in sample districts

Data pertaining to yield of different varieties of soybean infested by YMV in selected districts is given in **Table 5.** The yield data of same variety compared with other varieties shows very small differences due to at par infestation of YMV in the different varieties. The study indicates that the variety JS 95-60 occupied maximum area in the selected districts. Major varieties namely JS-95-60, JS-335 and JS-93-05 suffered with heavy yield losses of >60% against DAY of Kharif – 2015.

Table: 5 Yield losses under different varieties of soybean at YMV infested field

(Yield: Quintal/ha)

Varieties	Chhindwara		Ujjain		Betul		Mean
	Actual Yield	% yield loss	Actual Yield	% yield loss	Actual Yield	% yield loss	% yield loss
JS-95-60	1.48	-81	1.98	-69	0.98	-41	64
JS-335	1.39	-83	1.91	-70	1.15	-31	61
JS-93-05	1.19	-85	2.00	-69	0.94	-44	66

5.5 Economics losses due to infestation of YMV

The economics of soybean production at sampled farms is presented in **Table 6.** Cost of cultivation of soybean is estimated Rs.20,200/- Rs.1,9700/- and Rs.19,900/- in Chhindwara, Ujjain and Betul districts respectively with an average cost of Rs.19,333/- per ha. It shows that the cost of cultivation is almost at par with the average cost across the sample districts. The higher cost of cultivation attributes to higher cost of seeds, fertilizer, PP measures and mechanical operations of sowing and harvesting. Heavy infestation of YMV resulted into heavy yield losses. The yield of soybean was reduced to 1.97 Qtl. /ha in Ujjain followed by 1.38 Qtl. /ha in Chhindwara and 1.08 Qtl./ha in Betul district. The average gross return with this level of yield comes to Rs.5910/- per ha in Ujjain followed by Rs.4,140/- per ha in Chhindwara and Rs. 3,240/- per ha in Betul districts. The average input-output ratio varied from 1:0.30 in Ujjain, 1:0.20 in Chhindwara and 1:0.16 in Betul districts. Thus, the soybean farmers suffered on an average a loss of >Rs. 15000/- per ha.

Table: 6 Economics of soybean production at sampled farms

Particulars of operation	Chhindwara	Ujjain	Betul	Overall Average
Input cost (Rs/ha)	20200	19700	19900	**19933**
Yield (Qtl./ha)	1.38	1.97	1.08	**1.48**
Average price (Rs/quintal)	3000	3000	3000	**3000**
Gross return (Rs/ha)	4140	5910	3240	**4440**
Net return (Rs/ha)	-16060	-13790	-16660	**-15493**
Input-output ratio	1: 0.20	1:0.30	1:0.16	**1:0.22**

5.6 Farmer's perceptions / knowledge about adoption of recommended technologies of soybean production.

District wise information in respect of adoption of recommended technology of soybean production *i.e.* modalities of soil health analysis, preparatory tillage, Integrated nutrient management, recommended promising cultivars of soybean, seed treatment, time and method of sowing, intercultural/hoeing, method and frequency of irrigation, integrated weed management and integrated pest management is given in ***Annexure –I (c).*** Overall perception and adoption level of technologies is given in ***Annexure – I (d).***

A perusal of data in ***Annexure-I (d)*** shows that remarkably high proportion of the respondents (83 %) possessed knowledge about modalities of soil health analysis and 64 % respondents adopted modalities of soil health analysis. 76 % farmers have knowledge about recommended promising cultivars of soybean but 63 % farmers adopted recommended cultivars. 88 % farmers know about time, method & improved machines of soybean harvesting & threshing, whereas, 59 % only adopted these recommendations. Similarly, 39 % farmers have knowledge about reliable source of improved agriculture machines but 22 % farmers only adopted. It is concluded that the remarkable gap observed between knowledge and adoption level of technology at farmers field.

5.7 Farmer's perception about infestation of YMV in soybean

Perception of farmer's perspective on the soybean YMV in selected district of M.P. is given in the ***Annexure- I (d)*** shows that 69.17 % farmers perceived heavy, 25 % farmers perceived moderate and only 5.83 % farmers perceived presence of white fly population in soybean. As regards, approximate date of infestation of YMV was observed by the farmer 73 % farmers and 27 % farmers perceived occurrence of YMV at 50 days and 30 days after sowing respectively. None of them perceived occurrence of YMV at 75 days after sowing. Perceptions of farmers about stage of crop when YMV occurred, 52 % farmers perceived at flowering stage and 48 % farmers perceived at pod filling stage. Seed treatment in soybean was adopted by only 44% respondents and other control measures of YMV were adopted by 83% farmers but no innovative method for control of YMV was adopted by the sample farmers.

It is concluded that knowledge & adoption level of selected farmers about the control of YMV and recommended practices is low as IWM and IPM resulting the yield loss due to YMV during Kharif 2015.

6. Suggestions / Recommendations

Based on the findings of the study and feedback from the farmers the following suggestions / recommendations are made:

6.1. Strengthening of "Pest Surveillance Mechanism", capacity building of field functionaries / farmers and issue of timely advisories to the farmers.

6.2. Adoption of crop cafeteria including YMV resistant varieties, crop rotation, improved planting method like Broad-Bed-Furrow (BBF), Ridge-Furrow (R&F) and inter-cropping.

6.3. Use of YMV resistant varieties of soybean like JS-20-29, JS-20-69, RKS-24 and JS-97-52 recommended for the State.

6.4. Seed treatment with Thiram 2gm + Carbendazim 1gm per kg of seeds.

6.5. Control of white fly with the spray of thiamethoxam 25WG@100 gm 500 ltr. Water / ha.

6.6. Control of white fly and other sucking pest/ Thrips etc. with community based approach.

6.7. To discourage indiscriminate use of pesticides, this causes insurgence of white fly.

6.8. To maintain optimum plant population, balance use of fertilizers based on soil health card.

7. References

Chauhan, G. S. and Joshi, O. P. (2005) Soybean (Glycine max) - the 21st Century crop .Indian Journal of Agriculture Science, 75(8) : 461-469.

Nene, Y. L. (1972) A Survey of the viral diseases of pulse crop in India. *Indian Journal Research Bull*. **4**:191

FAO (2013). faostat.fao.org/site/567/default.aspx#ancor

Anonymous (2016) Proceeding of Workshop on "*Selection of resistant varieties of soybean for YMV and other biotic and a-biotic stresses*" held at ICAR-IISR, Indore on 15th February, 2016.

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Annexure -I (a)

Farmer's perceptions about the causes of outbreak of YMV in soybean

S. No.	Reasons Given By Farmers	Chhindwara (N=40) & %	Ujjain (N=40) & %	Betul (N=40) & %	Overall (N=120) & %
01.	Continues dry spell in the month of June-July, 2015	40 (100.0)	40 (100.0)	40 (100.0)	120 (100.0)
02.	Continues high temperature in the peak crop period form 15 August-15 Sept	40 (100.0)	40 (100.0)	40 (100.0)	120 (100.0)
03.	Heavy rains during 15 July to 25 July	40 (100.0)	40 (100.0)	40 (100.0)	120 (100.0)
04.	Failure effect of PP chemicals on YMV infested crop	34 (85.00)	29 (75.00)	28 (70.00)	91 (76.00)
05.	High degree of YMV infestation on crop	40 (100.0)	40 (100.0)	40 (100.0)	120 (100.0)
06.	Heavily/uniformly speared of YMV	40 (100.0)	36 (90.00)	40 (100.0)	120 (100.0)
07.	Use of save seed/previous year seed	20 (50.00)	22 (55.00)	26 (65.00)	68 (57.00)
08.	Not proper effect of fungicide on YMV due to inferior quality	30 (75.00)	25 (63.00)	28 (70.00)	83 (69.00)
09.	Lack of adoption of crop rotation practices	32 (80.00)	29 (73.00)	33 (83.00)	94 (78.00)
10.	Lack of scientific seed treatment practise	30 (75.00)	25 (63.00)	22 (55.00)	77 (64.00)
11.	Disturbance in the sowing period due to unfavourable monsoon during the period	35 (88.00)	36 (90.00)	35 (88.00)	106 (88.00)
12.	Sowing of urd/mung simultaneously with soybean crop as its sensitive to YMV & host plant for White fly	19 (48.00)	22 (55.00)	18 (45.00)	59 (49.00)
13.	Lack of fields/bunds sanitation of crop residuals of previous season	22 (55.00)	20 (50.00)	24 (60.00)	66 (55.00)
14.	Lack of summer deep ploughing	27 (68.00)	18 (45.00)	19 (48.00)	64 (53.00)
15.	Lack of soil testing practise before sowing crop	25 (63.00)	20 (50.00)	24 (60.00)	69 (58.00)
16.	Lack of awareness about recommended use of fertilizer application on crops	35 (88.00)	32 (80.00)	30 (75.00)	97 (81.00)
17.	Unawareness about varietal preferences for particular	26 (65.00)	24 (60.00)	24 (60.00)	74 (62.00)

	ecology/situations				
18.	Lack/unawareness about pest/disease identification & their suitable control measures	38 (95.00)	35 (88.00)	35 (88.00)	108 (90.00)
19.	Lack of timely assistance from SDA/ICAR/KVK to control it timely	25 (63.00)	29 (73.00)	27 (68.00)	81 (68.00)

Note: Figures in the parentheses indicate the percentages to the total farmers.

Annexure -I (b)

Farmer's perceptions about the causes of outbreak of YMV in soybean

S. No	Farmer's Perception	Chhindwara (N=40) & %	Ujjain (N=40) & %	Betul (N=40) & %	Overall (N=120) & %
1.	Presence of white fly population				
	Heavy	30 (75.00)	25 (63.00)	28 (70.00)	**83 (69.17)**
	Moderate	08 (20.00)	10 (25.00)	12 (30.00)	**30 (25.00)**
	Low	02 (5.00)	05 (12.00)	-	**07 (5.83)**
2.	Approximate date when infestation of YMV was observed by the farmer				
	25 DAS	15 (37.00)	10 (25.00)	08 (20.00)	**33 (27.00)**
	50 DAS	25 (63.00)	30 (75.00)	32 (80.00)	**87 (73.00)**
	75 DAS	-	-	-	-
3.	Stage of crop when YMV was occurred				
	Vegetative stage	-	-	-	-
	Flowering stage	20 (50.00)	22 (55.00)	20 (50.00)	**62 (52.00)**
	Pod filling stage	20 (50.00)	18 (45.00)	20 (50.00)	**58 (48.00)**
4	Whether seed treated with fungicide/insecticide				
	Yes	18 (45.00)	15 (38.00)	20 (50.00)	**53 (44.00)**
	No	22 (55.00)	25 (63.00)	20 (50.00)	**67 (56.00)**
5	Spread of YMV, whether				
	uniform	40 (100)	40 (100)	40 (100)	**120 (100)**
	sporadic	-	-	-	-
6	Effect of YMV on plant growth				
	stunted	40 (100)	40 (100)	40 (100)	**120 (100)**
	excess growth	-	-	-	-
7	Degree of infestation in soybean field				
	Heavy	40 (100)	40 (100)	40 (100)	**120 (100)**
	Moderate	-	-	-	-
	Low	-	-	-	-
8	Frequency of YMV infestation during last 10 years in soybean crop.				
	Yes	05 (12.00)	02 (05.00)	07 (18.00)	**14 (12.00)**
	No	35 (88.00)	38 (95.00)	33 (82.00)	**106 (88.00)**
9	Major insect/pests observed in field other than YMV				
	Yes	29 (73.00)	31 (78.00)	34 (85.00)	**94 (78.00)**
	No	11 (27.00)	09 (22.00)	06 (15.00)	**26 (22.00)**
10	Control measures adopted by the farmer for YMV				
	Yes	34 (85.00)	36 (90.00)	30 (75.00)	**100 (83.00)**
	No	06 (15.00)	04 (10.00)	10 (25.00)	**20 (17.00)**
11	Any support/assistance/technology/training provided by SDA/ICAR/SAU				
	Yes	25 (63.00)	22 (55.00)	24 (60.00)	**71 (59.00)**
	NO	15 (37.00)	18 (45.00)	16 (40.00)	**49 (41.00)**
	If yes, from where				
	SDA	20 (80.00)	18 (82.00)	20 (83.00)	**58 (82.00)**
	ICAR	05 (20.00)	-	-	**05 (7.00)**
	SAU	-	04 (18.00)	04 (17.00)	**08 (11.00)**

12	Any innovative method adopted by the farmer for control of YMV				
	Yes	-	-	-	-
	No	40 (100)	40 (100)	40 (100)	**120 (100)**

Annexure - I (c)

Farmer's perceptions / knowledge about adoption of recommended technologies of soybean production

S. NO.	Technological aspects of soybean cultivation	Number of farmers					
		Chhindwara (N=40) & %		Ujjain (N=40) & %		Betul (N=40) & %	
		Knowledge level	Adoption level	Knowledge level	Adoption level	Knowledge level	Adoption level
1.	Modalities of soil health analysis	31 (78.00)	20 (50.00)	35 (88.00)	28 (70.00)	34 (85.00)	29 (73.00)
2.	Preparatory tillage	30 (75.00)	25 (63.00)	25 (63.00)	22 (55.00)	26 (65.00)	25 (63.00)
3.	Integrated nutrient management :-						
(a)	Crop specific recommended dose and method of application of manure,	21 (53.00)	16 (40.00)	19 (48.00)	14 (35.00)	14 (35.00)	14 (35.00)
(b)	Crop specific recommended dose, time and method of application of fertilizers	21 (53.00)	13 (33.00)	21 (53.00)	12 (30.00)	12 (30.00)	12 (30.00)
(c)	Crop specific recommended dose, time and method of application of micronutrients	19 (48.00)	10 (25.00)	19 (48.00)	22 (55.00)	22 (55.00)	22 (55.00)
(d)	Crop specific recommended dose, time and method of application of gypsum.	17 (43.00)	08 (20.00)	12 (30.00)	07 (18.00)	16 (40.00)	09 (23.00)
(e)	Crop specific recommended dose, time and method of application of lime.	19 (48.00)	08 (20.00)	16 (40.00)	09 (23.00)	14 (35.00)	09 (23.00)
4.	Do you Know about recommended list of promising cultivars of soybean?	29 (73.00)	22 (55.00)	30 (75.00)	25 (63.00)	32 (80.00)	28 (70.00)
5.	Seed treatment	23 (58.00)	16 (40.00)	20 (50.00)	19 (48.00)	19 (48.00)	10 (25.00)

6.	Time and method of sowing	23 (58.00)	18 (45.00)	28 (70.00)	15 (38.00)	21 (53.00)	19 (48.00)
7.	Interculture/hoeing.	33 (83.00)	30 (75.00)	30 (75.00)	30 (75.00)	30 (75.00)	29 (73.00)
8.	Method and frequency of irrigation	28 (70.00)	09 (23.00)	30 (75.00)	14 (35.00)	33 (83.00)	18 (45.00)
9.	Integrated Weed management	17 (43.00)	08 (20.00)	11 (28.00)	12 (30.00)	12 (30.00)	11 (28.00)
10.	Integrated pest management:-	19 (48.00)	08 (20.00)	22 (55.00)	11 (28.00)	22 (55.00)	10 (25.00)
(a)	Identification of insect pests/diseases.	15 (38.00)	05 (13.00)	08 (20.00)	05 (13.00)	10 (25.00)	04 (16.00)
(b)	Recommended cultural methods	14 (35.00)	05 (13.00)	11 (28.00)	04 (16.00)	10 (25.00)	04 (16.00)

S. NO.	Technological aspects of soybean cultivation	Number of farmers					
		Chhindwara (N=40) & %		Ujjain (N=40) & %		Betul (N=40) & %	
		Knowledge level	Adoption level	Knowledge level	Adoption level	Knowledge level	Adoption level
(c)	Recommended physical practices	10 (25.00)	05 (13.00)	07 (18.00)	04 (16.00)	11 (28.00)	04 (16.00)
(d)	Use of Bio-pesticides	22 (55.00)	12 (30.00)	20 (50.00)	15 (38.00)	25 (63.00)	18 (45.00)
(e)	Use of Bio-agents	23 (58.00)	09 (23.00)	18 (45.00)	07 (18.00)	19 (48.00)	08 (20.00)
(f)	Name and method of PP Chemicals use	28 (70.00)	16 (40.00)	30 (75.00)	21 (53.00)	32 (80.00)	21 (53.00)
11.	Do you know about time, method & improved machines of soybean harvesting & threshing	35 (88.00)	24 (60.00)	36 (90.00)	25 (63.00)	35 (88.00)	22 (55.00)
12.	Knowledge level of sources of information for improved/modern package of practices of crop cultivation	16 (40.00)	06 (15.00)	12 (30.00)	07 (18.00)	11 (28.00)	08 (20.00)
13	Knowledge about proper crop storage	20 (50.00)	20 (50.00)	18 (45.00)	10 (25.00)	21 (53.00)	11 (28.00)
14.	Knowledge level of soybean market/mandies	30 (75.00)	26 (65.00)	20 (50.00)	17 (43.00)	31 (78.00)	26 (65.00)
15.	Knowledge level of reliable source of improved agriculture machines	21 (53.00)	07 (18.00)	16 (40.00)	09 (23.00)	10 (25.00)	10 (25.00)

Note: (*) Figures in the parentheses indicate the percentages to the total number of farmer's knowledge level

(**) Figures in the parentheses indicate the percentages to the total number of farmer's adoption level of particular knowledge

Annexure -I(d)

Overall perceptions farmer's about adoption of recommended technologies of soybean production

S. NO	Technological aspects of soybean cultivation	Knowledge level of recommended technology (N=120)		Adoption level of recommended technology (N=120)	
		Overall Perception level	%	Overall Perception level	%
1.	Modalities of soil health analysis	100	83.00	77	64.00
2.	Preparatory tillage	81	68.00	72	60.00
3.	Integrated nutrient management :-				
(a)	Crop specific recommended dose and method of application of manure,	54	45.00	44	37.00
(b)	Crop specific recommended dose, time and method of application of fertilizers	54	45.00	37	31.00
(c)	Crop specific recommended dose, time and method of application of micronutrients	60	50.00	54	45.00
(d)	Crop specific recommended dose, time and method of application of gypsum.	45	38.00	24	20.00
(e)	Crop specific recommended dose, time and method of application of lime.	49	41.00	26	22.00
4.	Do you Know about recommended list of promising cultivars of soybean?	91	76.00	75	63.00
5.	Seed treatment	62	52.00	45	38.00
6.	Time and method of sowing	72	60.00	52	43.00
7.	Interculture/hoeing.	93	78.00	89	74.00
8.	Method and frequency of irrigation	91	76.00	41	34.00
9.	Integrated Weed management	40	33.00	31	26.00
10.	Integrated pest management:-	63	53.00	29	24.00
(a)	Identification of insect pests/diseases.	33	28.00	14	12.00
(b)	Recommended cultural methods	35	29.00	13	11.0

					0
(c)	Recommended physical practices	28	23.00	13	11.00
(d)	Use of Bio-pesticides	67	56.00	45	38.00
(e)	Use of Bio-agents	60	50.00	24	20.00
(f)	Name and method of PP Chemicals use	90	75.00	58	48.00
11.	Do you know about time, method & improved machines of soybean harvesting & threshing	106	88.00	71	59.00
12.	Do you know about of sources of information for improved/modern package of practices of crop cultivation?	39	33.00	21	18.00
13	Knowledge about proper crop storage	59	49.00	41	26.00
14.	Knowledge level of soybean market/mandies	81	68.00	69	58.00
15.	Knowledge level of reliable source of improved agriculture machines	47	39.00	26	22.00

Note: **(*)** Figures in the parentheses indicate the percentages to the total number of farmer's knowledge level

(**) Figures in the parentheses indicate the percentages to the total number of farmer's adoption level of particular knowledge.

Annexure -II (a)

Weekly temperature from June to September during last 05 years in Chhindwara district (Temp. in ^{o}C)

Month / Weeks	Kharif 2011		Kharif 2012		Kharif 2013		Kharif 2014		Kharif 2015		Average (2011-14)		Difference	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
June														
1st week	39.6	28.1	36.8	26.5	38.4	27.4	43.0	32.7	34.6	27.5	39.5	28.7	**-5**	**-1**
2nd week	37.0	26.6	35.7	24.9	31.0	23.3	38.1	28.9	32.7	25.6	35.5	25.9	**-3**	**0**
3rd week	29.9	22.8	30.7	23.4	31.4	23.1	35.6	26.7	31.5	25.0	31.9	24.0	**0**	**1**
4th week	27.2	22.8	34.6	25.7	27.9	23.0	36.5	28.5	32.6	25.9	31.6	25.0	**1**	**1**
Month Average	**33.4**	**25.21**	**34.5**	**25.1**	**32.2**	**24.20**	**38.3**	**29.2**	**32.9**	**26.0**	**34.6**	**25.9**	**-2**	**0**
July														
1st week	30.3	23.1	30.3	23.6	26.7	21.9	35.9	28.3	28.6	24.9	30.8	24.2	**-7**	**3**
2nd week	29.4	23.6	29.1	23.3	28.1	23.3	34.5	27.3	29.7	25.6	30.3	24.4	**-2**	**5**
3rd week	26.6	22.7	29.9	23.3	28.0	23.1	28.5	24.6	28.4	23.8	28.3	23.4	**1**	**2**
4th week	28.1	21.9	26.2	22.4	25.9	22.9	26.7	22.8	28.2	23.3	26.7	22.5	**6**	**4**
5th week	-	-	25.5	21.9	26.6	22.5	28.1	24.2	27.2	22.5	26.7	22.9	**2**	**-2**
Month Average	**28.6**	**22.8**	**28.2**	**22.9**	**27.1**	**22.74**	**30.7**	**25.4**	**28.4**	**24.0**	**28.6**	**23.5**	**0**	**2**
August														
1st week	25.7	23.0	24.9	22.0	27.1	22.4	29.1	23.7	29.3	24.4	26.7	22.8	**10**	**7**
2nd week	27.9	22.3	24.8	21.3	27.4	22.7	30.8	24.0	30.7	23.5	27.7	22.6	**11**	**4**
3rd week	29.0	22.6	27.3	22.0	24.8	21.5	30.8	24.4	30.7	24.3	28.0	22.6	**10**	**7**
4th week	28.7	22.4	29.6	22.6	28.0	22.5	29.7	24.0	30.8	23.3	29.0	22.9	**6**	**2**
Month Average	**27.8**	**22.6**	**26.7**	**22.0**	**26.8**	**22.28**	**30.1**	**24.0**	**30.4**	**23.9**	**27.9**	**22.7**	**9**	**5**
September														
1st week	26.6	22.6	28.4	22.4	30.2	21.4	28.3	24.2	32.4	24.3	28.4	22.7	**14**	**7**
2nd week	28.4	21.6	28.8	22.4	31.8	21.8	29.5	23.7	29.7	23.3	29.6	22.4	**0**	**4**
3rd week	29.9	22.4	29.1	21.7	29.1	22.3	31.7	23.6	31.0	22.2	30.0	22.5	**4**	**-1**
4th week	30.7	19.3	30.7	20.1	29.4	21.2	33.6	22.6	32.5	22.2	31.1	20.8	**5**	**7**
Month Average	**28.9**	**21.5**	**29.3**	**21.7**	**30.1**	**21.68**	**30.8**	**23.5**	**31.4**	**23.0**	**29.8**	**22.1**	**6**	**4**

Weekly rainfall from June to September during last 05 years in Chhindwara

(Rainfall in millimetres)

Month / Weeks	Kharif 2011	Kharif 2012	Kharif 2013	Kharif 2014	Kharif 2015	Average (2011-14)	Deviation
June							
1st week	1	0	10	0	51	2.8	1755
2nd week	4	32	139	0	53	43.8	21
3rd week	10	78	62	12	8	40.5	-80
4th week	5	14	79	42	15	35.0	-57
Month Total	**20.0**	**124.0**	**290.0**	**54.0**	**127.0**	**122.0**	**4**
July							
1st week	5	27	108	5	89	36.3	146
2nd week	16	39	34	8	12	24.3	-51
3rd week	24	28	84	130	82	66.5	23
4th week	10	70	65	125	9	67.5	-87
5th week	11	66	104	55	199	59.0	237
Month Total	**66.0**	**230.0**	**395.0**	**323.0**	**391.0**	**253.50**	**54**
August							
1st week	5	146	25	8	114	46.0	148
2nd week	9	28	44	0	5	20.3	-75
3rd week	8	61	164	38	41	67.8	-39
4th week	27	66	1	82	69	44.0	57
Month Total	**49.0**	**301.0**	**234.0**	**128.0**	**229.0**	**178.0**	**29**
September							
1st week	5	153	0	63	7	55.3	-87
2nd week	16	97	1	20	58	33.5	73
3rd week	0	66	70	0	0	34.0	-100
4th week	0	33	42	0	0	18.8	-100
Month Total	**21.0**	**349.0**	**113.0**	**83.0**	**65.0**	**141.5**	**-54**

Source: SDA, Chhindwara

Annexure-II (b)

Weekly temperature from June to September during last 05 years of Ujjain district

(Temp Degree Centigrade)

Month/ Weeks	Kharif 2011		Kharif 2012		Kharif 2013		Kharif 2014		Kharif 2015		Average (2011-14)		Difference	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
June														
1st week	39.1	25.56	39.0	26.5	40.7	28.2	43.4	26.7	40.5	26.6	40.55	26.74	0	0
2nd week	40.4	23.9	37.5	26.1	36.7	25.3	39.6	24.5	36.0	23.9	38.55	24.95	-3	-1
3rd week	36.9	22.9	38.3	26.6	32.4	23.8	37.3	24.2	35.5	23.0	36.23	24.38	-1	-1
4th week	30.1	22.6	37.0	26.6	30.9	24.1	37.5	24.5	32.7	22.8	33.88	24.45	-1	-2
5th week	30.2	22.1	37.6	26.6	29.9	23.6	36.5	24.4	33.9	22.7	33.55	24.18	0	-1
Month Average	**35.54**	**23.41**	**37.88**	**26.48**	**34.12**	**25.00**	**38.86**	**24.86**	**35.72**	**23.8**	**36.55**	**24.95**	**-1**	**-1**
July														
1st week	34.4	21.7	33.6	27.3	28.6	24.0	37.1	24.8	33.3	24.0	33.43	24.45	0	0
2nd week	32.1	21.1	31.3	24.2	29.7	24.0	36.5	24.0	32.8	24.5	32.40	23.33	0	1
3rd week	30.3	21.4	32.1	25.0	27.5	23.1	29.8	21.9	31.6	23.9	29.93	22.85	2	1
4th week	28.0	20.6	26.2	23.1	28.2	23.5	26.7	21.1	26.7	22.4	27.28	22.08	-1	0
5th week	32.7	21.77	26.4	21.3	25.2	23.0	29.9	21.8	26.9	21.2	28.55	21.97	-2	-1
Month Average	**31.50**	**21.31**	**29.92**	**24.18**	**27.84**	**23.52**	**32.00**	**22.72**	**30.26**	**23.20**	**30.32**	**22.93**	**0**	**0**
August														
1st week	29.7	21.5	28.8	23.4	28.3	22.8	29.0	21.5	29.4	22.4	28.95	22.30	0	0
2nd week	26.3	20.2	25.9	23.0	28.0	23.0	28.5	20.7	28.6	22.1	27.18	21.73	1	0
3rd week	38.8	20.6	26.5	22.2	29.5	23.3	29.3	20.8	24.7	23.0	31.03	21.73	-6	1
4th week	30.9	21.0	28.6	22.6	26.7	23.0	33.6	21.7	30.3	22.2	29.95	22.08	0	0
5th week	31.4	20.8	30.58	23.5	28.8	22.3	32.8	21.1	31.8	22.0	30.90	21.93	1	0
Month Average	**31.42**	**20.82**	**28.07**	**22.94**	**28.26**	**22.88**	**30.64**	**21.16**	**28.96**	**22.34**	**29.60**	**21.95**	**-1**	**0**
September														

1st week	30.4	20.3	32.1	23.9	35.7	24.8	29.5	20.9	32.4	21.5	31.93	22.48	0	-1
2nd week	29.3	20.38	30.2	23.1	40.8	22.9	27.9	20.4	35.3	21.7	32.05	21.70	3	0
3rd week	31.7	20.7	29.3	22.4	34.1	23.4	32.2	18.8	32.0	21.9	31.83	21.33	0	1
4th week	32.6	19.5	31.7	22.1	30.4	22.3	34.0	17.2	32.4	19.1	32.18	20.28	0	-1
5th week	34.76	18.7	33.1	21.4	30.2	23.0	35.5	17.4	35.5	20.0	33.39	20.13	2	0
Month Average	**31.75**	**19.91**	**31.28**	**22.58**	**34.24**	**23.28**	**31.82**	**18.94**	**33.52**	**20.84**	**32.27**	**21.18**	**1**	**0**

Source: SDA, Ujjain

<u>Annexure-II (b)Contd...</u>

<u>Weekly rainfall from June to September during last 05 years of Ujjain</u>

(Rainfall in MM)

Month/Weeks	**Kharif 2011**	**Kharif 2012**	**Kharif 2013**	**Kharif 2014**	**Kharif 2015**	**Average (2011-14)**	**Deviation**
June							
1st week	0.0	0.0	0.3	3.3	0.0	0.9	**-100**
2nd week	32.5	6.8	38.1	24.8	108.0	25.6	**323**
3rd week	22.5	23.9	65.7	0.0	56.6	28.0	**102**
4th week	78.1	0.0	43.2	0.0	97.2	30.3	**221**
5th week	2.4	0.0	62.0	0.0	11.2	16.1	**-30**
Month Total	**135.5**	**30.7**	**209.3**	**28.1**	**273**	**100.9**	**171**
July							
1st week	2.6	70.6	156.2	0.0	0.4	57.4	**-99**
2nd week	88.6	85.5	57.2	40.1	0.0	67.9	**-100**
3rd week	148.5	16.4	95.4	119.6	145.3	95.0	**53**
4th week	152.0	221.6	147.6	93.1	598.0	153.6	**289**
5th week	22.5	77.7	34.3	41.3	100.2	44.0	**128**
Month Total	**414.2**	**471.8**	**490.7**	**294.1**	**843.9**	**417.7**	**102**
August							
1st week	89.3	2.0	122.3	11.1	7.1	56.2	**-87**
2nd week	128.6	158.2	38.1	41.6	101.8	91.6	**11**
3rd week	36.6	54.9	56.6	7.7	63.0	39.0	**62**
4th week	108.7	12.1	131.3	23.0	28.1	68.8	**-59**
5th week	70.5	46.4	50.71	58.5	21.9	56.5	**-61**
Month Total	**433.7**	**273.6**	**399.01**	**141.9**	**221.9**	**312.1**	**-29**
September							
1st week	66.4	13.1	2.2	65.3	5.7	36.8	**-84**

2nd week	28.8	173.6	3.1	58.9	0.0	66.1	**-100**
3rd week	47.7	40.2	72.0	7.0	28.3	41.7	**-32**
4th week	6.7	9.3	24.0	0.6	0.0	10.2	**-100**
5th Month	0.0	15.3	12.9	0.3	0.0	7.1	**-100**
Total week	**149.6**	**251.5**	**114.2**	**132.1**	**34**	**161.9**	**-79**

Source: SDA, Ujjain

Annexure -II (c)

Weekly temperature from June to September during last 05 years in Betul district (Temp. in ^{o}C)

Month / Weeks	Kharif 2011		Kharif 2012		Kharif 2013		Kharif 2014		Kharif 2015		Average (2011-14)		Difference	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
June														
1st week	37.6	27.1	38.8	28.5	37.4	27.4	41.0	32.7	35.6	27.5	**38.70**	**28.93**	**-3**	**-1**
2nd week	37.0	26.6	35.7	24.9	31.0	23.3	38.1	28.9	32.7	25.6	**35.45**	**25.93**	**-3**	**0**
3rd week	29.9	22.8	30.7	23.4	31.4	23.1	35.6	26.7	31.5	25.0	**31.90**	**24.0**	**0**	**1**
4th week	27.2	22.8	34.6	25.7	27.9	23.0	36.5	28.5	32.6	25.9	**31.55**	**25.00**	**1**	**1**
Month Average	**32.92**	**24.82**	**34.95**	**25.62**	**31.92**	**24.20**	**24.20**	**37.8**	**29.2**	**33.1**	**34.40**	**25.96**	**-1**	**0**
July														
1st week	30.6	23.1	30.3	23.6	26.7	21.9	35.9	28.3	28.6	24.9	30.88	24.23	-2	1
2nd week	29.4	23.6	29.5	23.3	28.1	23.3	33.5	27.3	29.7	25.6	30.13	24.38	0	1
3rd week	26.6	22.7	29.9	23.3	28.0	23.1	28.5	24.6	28.4	23.8	28.25	23.43	0	0
4th week	28.1	21.9	26.5	22.4	26.9	22.9	26.7	22.8	28.2	23.3	27.05	22.50	1	1
5th week	24.5	22.9	25.5	21.9	26.6	22.5	28.1	24.2	27.2	22.5	26.18	22.88	1	0
Month Average	**27.84**	**22.84**	**28.34**	**22.9**	**27.26**	**22.74**	**30.54**	**25.44**	**28.42**	**24.02**	**28.50**	**23.48**	**0**	**1**
August														
1st week	25.7	23.0	24.9	22.0	27.1	22.4	29.1	23.7	29.3	24.4	26.70	22.78	3	2
2nd week	27.9	22.3	24.8	21.3	27.4	22.7	30.8	24.0	30.7	23.5	27.73	22.58	3	1
3rd week	29.0	22.6	27.3	22.0	24.8	21.5	29.8	24.4	30.7	24.3	27.73	22.63	3	2
4th week	28.7	22.4	29.6	22.6	28.0	22.5	29.6	24.0	30.8	23.3	28.98	22.88	2	0
Month Average	**27.82**	**22.57**	**26.95**	**21.97**	**26.82**	**22.28**	**29.82**	**24.02**	**30.37**	**23.87**	**27.78**	**22.71**	**3**	**1**
September														
1st week	26.5	22.6	28.4	22.4	30.2	21.4	28.3	24.2	32.4	24.3	28.35	22.65	4	2
2nd week	28.4	21.6	28.8	22.4	31.8	21.8	29.5	23.7	29.7	23.3	29.63	22.38	0	1
3rd week	29.9	22.4	29.1	21.7	29.1	22.3	31.7	23.6	31.0	22.2	29.95	22.50	1	0
4th week	30.7	19.3	31.2	20.1	29.4	21.1	33.6	22.6	32.5	22.5	31.23	20.78	1	2
Month Average	**28.87**	**21.47**	**29.37**	**21.65**	**30.12**	**21.65**	**30.77**	**23.52**	**31.4**	**2307**	**29.79**	**22.08**	**2**	**1**

Source: SDA, Betul

Annexure-II (c) Contd.....

Weekly rainfall from June to September during last 05 years of Betul district

(Rainfall in mm)

Month/ Weeks	Kharif 2011	Kharif 2012	Kharif 2013	Kharif 2014	Kharif 2015	Average (2011-14)	Deviation
June							
1st week	17.1	4.6	7.9	0	4.9	7.4	**-34**
2nd week	45.5	36.6	80.8	33.3	55.7	49.1	**14**
3rd week	39.7	128.1	64.3	5	92.1	59.3	**55**
4th week	93.3	3.7	141	0	51.1	59.5	**-14**
Month Total	**195.6**	**173**	**294**	**38.3**	**203.8**	**175.2**	**16**
July							
1st week	28.2	53.3	95.7	57.5	0	58.7	**-100**
2nd week	33.9	75.7	174.2	48.7	8.2	83.1	**-90**
3rd week	34.2	7.4	125.9	192.2	118.1	89.9	**31**
4th week	164.2	333.9	171.1	322.3	88.2	247.9	**-64**
Month Total	**260.5**	**470.3**	**566.9**	**620.7**	**214.5**	**479.6**	**-55**
August							
1st week	112.5	331.8	204.8	53	263.8	175.5	**50**
2nd week	47	101	64.7	12.3	124.8	56.3	**122**
3rd week	71.8	33.8	108.2	9.4	12.4	55.8	**-78**
4th week	95.3	82.1	320.6	104.6	19.9	150.7	**-87**
Month Total	**326.6**	**548.7**	**698.3**	**179.3**	**420.9**	**438.2**	**-4**
September							
1st week	100.7	288.3	0	75.9	14.8	116.2	**-87**
2nd week	45	61	17.6	68.7	21.6	48.1	**-55**
3rd week	19	4.7	31.7	28.6	54.5	21.0	**160**
4th week	0.6	41	53.8	0.5	0	24.0	**-100**
Month Total	**165.3**	**395**	**103.1**	**173.7**	**90.9**	**209.3**	**-57**

Source: SDA, Betul

Annexure -III (a)

Area, production and productivity Kharif & Rabi crops during last five years (2011-2015)

A. Chhindwara

(A = Area: 000 ha, P = Production: 000 tones, Y= Yield: kg/ha)

Crops	2010-11			2011-12			2012-13			2013-14			2014-15		
	A	**P**	**Y**	**A**	**P**	**Y**	**A**	**P**	**Y**	**A**	**P**	**Y**	**A**	**P**	**Y**
Cereals															
Paddy	20.20	40.25	2242	20.60	59.40	2885	23.20	68.60	2956	25.00	64.55	2582	27.60	73.14	2650
Jowar	27.38	48.84	1784	25.80	44.60	1550	12.50	24.30	718	14.20	24.28	1710	15.60	27.38	1755
Maize	98.60	535.77	4298	10.60	1016.90	4620	121.00	804.70	3498	180.80	962.04	5321	195.20	980.49	5023
TotalCereals	146.18	624.86		57.00	1120.90		156.70	897.60		220.00	1050.87		238.40	1081.01	
Pulses															
Arhar	25.16	34.74	1381	27.56	49.20	1634	30.10	62.50	2070	28.00	61.04	2180	31.70	71.80	2265
Urd	8.34	1.01	217	8.43	4.30	340	11.50	5.00	106	12.00	5.04	420	7.30	3.07	420
Moong	1.63	0.40	246	2.53	0.40	400	3.20	1.30	120	3.50	1.47	420	3.60	1.51	420
Total Pulses	35.13	36.15		38.52	53.90		44.80	68.80		43.50	67.55		42.60	76.38	
Oilseeds															
Groundnut	23.27	63.42	2725	27.20	25.90	2363	27.30	25.50	948	22.00	38.50	1750	20.50	37.93	1850
Soybean	184.70	254.44	1736	190.00	176.10	2100	169.00	136.40	1042	100.70	136.45	1355	95.70	82.78	865
Niger	13.39	3.20	239	10.99	2.80	324	8.91	4.70	459	10.00	2.66	266	10.50	3.68	350
Til	0.70	0.34	487	0.72	1.10	380	2.00	0.90	458	2.00	0.92	460	2.00	0.92	462
Total Oilseeds	**198.79**	**257.98**		**201.71**	**180.00**		**179.91**	**142.00**		**112.70**	**140.03**		**108.20**	**87.38**	
Cotton	33.90	0.00	1800	33.77	60.40	1925	30.10	64.80	1691	40.31	60.39	1498	42.80	68.91	1610
Kodo/ Kutki	22.98	9.61	418	25.80	7.90	360	26.00	14.20	303	26.00	11.18	430	27.50	12.51	455
Rabi crops															
Cereals															
Wheat	122.10	809.68	6383	157.20	785.20	4520	171.00	791.20	4592	172.00	732.55	4259	165.40	565.50	3250
Pulses															
Gram	42.95	117.82	2743	55.00	155.40	2825	58.00	161.00	2260	60.00	138.00	2300	60.90	143.22	2310
Pea	5.40	3.58	542	6.70	4.50	658	7.00	4.90	722	8.00	5.84	730	8.10	6.25	735
Lentil	5.09	0.07	507	5.30	3.50	614	5.80	3.80	650	6.10	3.97	650	6.10	4.21	690
Total Pulses	53.44	121.47		67.00	163.40		70.80	169.70		74.10	147.81		75.10	153.68	
Oil seeds															
Rye sarso	0.60	0.37	1380	0.70	0.90	1288	0.90	1.20	1240	1.50	1.92	1280	2.70	3.81	1525
Linseed	0.90	0.29	1235	1.20	1.00	824	1.50	1.30	837	1.60	1.36	850	2.00	2.15	1075

Total oilseeds	**1.50**	**0.66**		**1.90**	**1.90**		**2.40**	**2.50**		**3.10**	**3.28**		**4.70**	**5.96**	
Other															
Sugarcane	6.10	80.24	6820	6.90	75.40	6790	11.00	76.90	6870	11.40	91.88	8060	4.50	101.50	8120

Source: SDA, Chhindwara

Annexure -III (b)

Area, production and productivity Kharif & Rabi crops during last five years (2011-2015)

B. **Ujjain**

(A = Area: 000 ha, Production: 000 tones, Yield: kg/ha)

Crops	2010-11			2011-12			2012-13			2013-14			2014-15		
	A	**P**	**Y**	**A**	**P**	**Y**	**A**	**P**	**Y**	**A**	**P**	**Y**	**A**	**P**	**Yield**
Cereals															
Rice	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maize	6.10	6.90	1131	5.90	6.28	1065	6.60	11.03	1671	7.20	5.16	716	6.34	10.82	1707
Jowar	2.60	2.30	885	2.30	1.54	671	0.30	0.30	985	0.55	0.31	564	0.41	0.66	1601
Total cereals	8.70	9.20		8.20	7.82		6.90	11.33		7.75	5.47		6.75	11.48	
Pulses															
Urad	2.00	0.80	400	2.30	0.76	329	1.20	0.43	361	2.20	0.91	412	1.06	1.05	989
Moong	0.20	0.10	500	0.20	0.07	327	0.30	0.11	361	0.30	0.07	248	0.30	0.16	544
Arhar	1.20	0.40	333	1.50	0.82	546	1.10	0.68	616	1.54	0.50	324	1.45	1.21	832
Total pulses	3.40	1.30		4.00	1.65		2.60	1.22		4.04	1.48		2.81	2.42	
Oilseed															
Til	N	N	617	0.03	0.02	675	0.09	0.04	494	0.03	0.03	935	0.10	0.07	737
G.nut	0.20	0.30	1500	0.20	0.31	1534	0.20	0.42	2081	0.20	0.20	980	0.10	0.20	2047
Soybean	451.80	502.80	1113	452.30	626.89	1386	453.60	665.43	1467	457.60	357.84	782	465.75	721.91	1550
Total oilseeds	452.00	503.10		452.53	627.22		453.89	665.89		457.83	358.07		465.95	722.18	
Rabi															
Cereals															
Wheat	135.10	237.80	1760	150.44	402.10	2673	182.90	556.09	3040	251.30	719.72	2864	194.30	586.01	3016
Barley	N	0.10	1889	0.00	0.00	0.00	0.10	0.00	2716	0.02	0.03	1400	0.00	0.00	1754
Total cereals	135.10	237.90		150.44	402.10		183.00	556.09		251.32	719.75		194.30	586.01	
Pulses															
Gram	212.70	134.90	634	197.01	150.52	764	182.40	163.98	899	148.50	155.18	1045	116.00	90.71	782
Pea	0.50	0.10	200	0.50	0.17	330	0.60	0.22	370	0.70	0.44	630	1.20	0.80	663
Lentil	0.40	0.10	250	0.30	0.10	349	0.40	0.15	379	0.00	1.06	0.00	0.00	0.00	0.00
Total pulses	0.90	0.20		0.80	0.27		1.00	0.37		0.70	1.50		1.20	0.80	
Oil seeds															
Mustard	1.70	1.30	765	1.90	2.14	1128	1.40	1.27	909	1.11	0.00	958	2.00	1.99	994

Linseed	0.30	0.20	667	0.20	0.20	1020	0.10	0.07	661	0.00	0.00	710	1.00	0.79	787
Total Oilseed	2.00	1.50		2.10	2.34		1.50	1.34		1.11	0.00		3.00	2.78	

Source: SDA, Ujjain

Annexure -III (c)

Area, production and productivity *Kharif* and *Rabi* crops during last five years (2011-2015).

C. Betul

(A = Area: 000 ha, P = Production:000 tones, Y = Yield: kg/ha)

	2010-11			2011-12			2012-13			2013-14			2014-15		
Crops	A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y
Cereals *Kharif*															
Paddy	43.30	64.21	1483	42.50	70.47	1658	42.60	91.93	2158	43.44	100.98	2324	43.35	105.42	2432
Jowar	42.20	55.07	1305	33.70	34.85	1034	21.50	23.59	1097	20.11	15.56	774	12.20	8.68	712
Maize	48.60	78.25	1610	49.60	72.22	1456	50.10	93.89	1874	53.08	55.05	1037	56.81	113.34	1995
Total cereals	134.10	197.53		125.80	177.54		114.20	209.41		116.63	171.59		112.36	227.44	5139
Pulses															
Arhar	29.00	23.06	795	28.00	18.34	655	25.70	21.07	820	23.12	18.82	814	20.53	16.22	790
Urd	8.10	3.32	410	6.60	1.83	278	5.00	2.30	460	3.51	0.82	234	3.58	1.22	340
Moong	1.10	0.48	435	1.20	0.30	253	1.10	0.43	395	1.10	0.23	205	1.30	0.37	290
Total pulses	38.20	26.86		35.80	20.47		31.80	23.80		27.73	19.87		25.41	17.81	1420
Oilseed															
Soybean	195.50	252.32	1290	206.90	262.56	1269	231.10	285.41	1235	241.31	136.58	566	236.12	152.29	645
Groundnut	5.50	6.35	1154	5.50	7.72	1404	5.20	6.91	1329	4.81	5.14	1068	4.61	3.29	715
Niger	18.90	7.18	380	19.00	4.07	214	15.60	4.84	310	9.35	2.34	250	6.72	1.75	260
Til	0.20	0.07	363	0.20	0.10	524	0.68	0.35	512	0.47	0.15	315	0.68	0.22	320
Total oil seeds	220.10	265.92		231.60	274.45		252.58	297.51		255.94	144.21	2199	248.13	157.55	1940
Kodo, Kutki & other	3.20	0.70	220	3.10	0.84	271	3.90	1.49	382	4.01	1.13	283	3.21	0.92	286
Cotton	0.30	0.16	530	0.20	0.14	722	0.30	0.16	520	0.21	0.10	450	0.32	0.15	460
Rabi															
Cereals															
Wheat	116.10	137.30	1183	100.70	212.10	2106	100.70	212.10	2106	118.70	310.10	2612	183.00	439.40	2401
Pulses															
Gram	40.30	14.30	355	38.80	50.00	1289	19.70	27.50	1396	51.00	27.80	654	36.00	33.37	927
Pea	4.10	0.40	98	3.50	1.80	514	3.40	1.70	500	3.50	2.20	629	2.00	1.38	690
Lentil	3.50	0.30	86	3.00	1.40	467	2.60	1.60	615	1.82	1.30	715	1.82	1.78	978
Total pulses	47.90	15.00		45.30	53.20	2270	25.70	30.80	2511	56.32	31.30	1998	39.82	36.53	2595

Oil seed															
Mustard	0.20	0.20	1000	0.30	0.40	1333	0.50	0.60	1200	0.41	0.50	1220	0.41	0.50	1220
Linseed	1.40	0.90	643	1.00	1.00	1000	0.50	0.40	800	0.64	0.50	781	0.30	0.25	833
Total oilseed	1.60	1.10		1.30	1.40	2333	1.00	1.00	2000	1.05	1.00	2001	0.71	0.75	2053
Sugarcane	4.10	14.60	3561	4.20	16.20	3857	4.00	22.70	5675	4.85	296.43	61119	7.00	467.60	66800

Source: SDA, Betul