

Workplan for 2013-14

Developing Chickpea Cultivars Suited to Mechanical Harvesting and Tolerant to Herbicides



**Submitted to
National Food Security Mission, Government of India**

Project partners

**International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad
Indian Institute of Pulses Research (IIPR), Kanpur
Indian Agricultural Research Institute (IARI), New Delhi
Punjab Agricultural University (PAU), Ludhiana
Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya (RVSKVV), Gwalior
University of Agricultural Sciences (UAS), Dharwad
Acharya NG Ranga Agricultural University (ANGRAU), Hyderabad**



**International Crops Research Institute
for the Semi-Arid Tropics**

This work
will be undertaken
as part of the



1. Project title: Developing chickpea cultivars suited to mechanical harvesting and tolerant to herbicides

2. Project duration: Four years (2013/14 to 2016/17)

3. Participating institutes

- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Hyderabad, AP
- Indian Institute of Pulses Research (IIPR), Kanpur, UP
- Indian Agricultural Research Institute (IARI), New Delhi
- Punjab Agricultural University (PAU), Ludhiana, Punjab
- Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya (RVSKVV), RAK College of Agriculture (RAKCA), Sehore, MP
- University of Agricultural Sciences (UAS), Dharwad, Karnataka
- Acharya NG Ranga Agricultural University (ANGRAU), RARS-Nandyal, AP

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5. Principal Investigators and Co-investigators

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6. Project goal: The overall goal of the project is to reduce the cost of chickpea cultivation and increase farmers' income by developing cultivars suited to mechanical harvesting and tolerant to herbicides.

7. Key objectives:

- Develop chickpea cultivars suited to mechanical harvesting;
- Modify/adjust combine harvesters to customize for chickpea harvesting;
- Develop chickpea cultivars tolerant to herbicides.

8. Major activities

- Fast-track for release the available breeding lines suitable for mechanical harvesting;

- Targeted breeding for development of cultivars suited to mechanical harvesting;
- Evaluate the available commercial harvesting machines and make required modifications/adjustments to customize for chickpea harvesting;
- Identify sources of herbicide tolerance from the germplasm and induce mutations for herbicide tolerance through mutagenesis;
- Develop herbicide-tolerant breeding lines.

9. Key outputs

- At least one cultivar suitable for mechanical harvesting released/proposed for release each in northern, central and southern India;
- New breeding lines suited to mechanical harvesting and adapted to each region developed through targeted breeding;
- Combine harvesters suitable for chickpea harvesting available;
- Sources of herbicide tolerance identified from germplasm/breeding lines or induced through mutation breeding;
- Breeding lines with enhanced herbicide tolerance developed for each target region.

10. Workplan for Year 1 (13 September 2013 to 31 March 2014)

Activity	Proposed workplan	Participating partners and target for each partner
(1) Organize a meeting of all partners for developing a detailed workplan of the project	<p>We propose to organize a meeting of all partners for developing a detailed workplan of the project, including selection of breeding materials/germplasm for use in the project, procedures for mutagenesis and screening for herbicide tolerance, protocols for conduct of station and multi-location trials and format for recording of observations and reporting of data.</p> <p>We have partially completed these tasks during August 2013. The ICAR organized the Annual Group Meet of AICRP on Chickpea at JNKVV Jabalpur on 24-26 August 2013. As most of the partners of this project were participating in the Annual Group Meet of AICRP on Chickpea, we used this opportunity to conduct a work planning meeting of this project in anticipation of its approval. We decided on different experiments and germplasm/breeding materials to be evaluated. The proceedings of this meeting are given in Annexure 1. We further refined the workplan by communicating through telephones and emails. The detailed workplan developed by the group is given below. We propose to organize a project launch meeting on</p>	This activity involves all the partners. However, ICRISAT being the lead institute is responsible for organizing the meeting and submitting the detailed workplan to NFSM by 30 September 2013.

Activity	Proposed workplan	Participating partners and target for each partner
	16 October 2013 at ICRISAT-Patancheru, where the workplan will be presented and further improved as per suggestions of the participants.	
(2) Evaluate available tall and upright breeding lines (suited to mechanical harvesting) in yield trials	Tall and upright breeding lines (suited to mechanical harvesting) already available with the participating centers will be evaluated in different yield trials (MHT-1, MHT-2, MHT-3) depending on the availability of seed and information, if any, on earlier evaluations. The requirement for maturity duration in chickpea varies from northern India to southern India. Northern India requires longer duration varieties, while southern India needs shorter duration varieties. Thus, the trials in northern India and central and southern India will have different entries.	
	MHT-1A: This trial consists of 30 entries, which include 28 breeding lines + 2 checks (tall cultivar HC 5 + one high yielding cultivar). The breeding lines have been contributed by ICRISAT (11), IIPR (10), IARI (3), PAU (3) and RARS-Nandyal (1). The trial will be in RBD with 3 reps. Each plot will have 3 rows of 4 m.	This trial will be conducted at 3 locations in northern India: (1) IIPR-Kanpur; (2) IARI-New Delhi; (3) PAU-Ludhiana. All centers will send seed to IIPR. IIPR will prepare seed packets and supply to partners.
	MHT-1B (Central and southern India Northern India): This trial consists of 22 entries, which include 20 breeding lines and 2 checks (JG 11 and JAKI 9218). The breeding lines have been contributed by ICRISAT (18), RARS-Nandyal (1) and RARS-Gulbarga (1). The trial will be in RBD with 3 reps. Each plot will have 4 rows of 4 m.	This trial will be conducted at four locations in central and southern India: (1) ICRISAT-Patancheru; (2) RARS-Nandyal; (3) UAS-Dharwad; (4) RAKC-Sehore. All centers will send seed to ICRISAT. ICRISAT will prepare seed packets and supply to partners.
	MHT-2: This trial consists of 100 entries which include 98 breeding lines + 2 checks (tall cultivar HC 5 + one high yielding cultivar). The entries include 80 from ICRISAT, 15 from IIPR, and 3 from IARI. This is a preliminary yield trial with plot size of a single row and min 3 reps.	This trial will be conducted at the following four locations: (1) ICRISAT-Patancheru; (2) IIPR-Kanpur; (3) IARI-New Delhi; (4) PAU-Ludhiana. All centers will send seed to ICRISAT. ICRISAT will prepare seed packets and supply to partners.

Activity	Proposed workplan	Participating partners and target for each partner
	MHT-3: This is a station trial / observation nursery where each participating center will evaluate its own breeding lines but seed available is not adequate for multi-location trials. Selected entries from these trials would be included in a multi-location trial in Year 2.	This trial will be conducted by those participating centers which have additional tall lines (not included in other trials) for evaluation.
(3) Targeted breeding for development of cultivars suited to mechanical harvesting.	Targeted breeding for developing tall and upright breeding lines will be initiated at each center. Donors will be supplied by ICRISAT and IIPR. Each center will make crosses (kabuli x kabuli and desi x desi separately) for improving selected cultivars for plant height and growth habit.	This activity will be carried out by all participating centers. Each center will make at least 4 crosses targeted for developing breeding lines suited to mechanical harvesting.
(4) Evaluate the available commercial combine harvesters for their suitability to chickpea harvesting	Functional testing of at least 2 selected harvesting machines for chickpea harvesting.	This activity will be carried out by the Department of Farm Machinery and Power Engineering, PAU-Ludhiana.
(5) Screen a new set of genotypes (germplasm/cultivars/breeding lines) for herbicide tolerance.	HTS-1: 300 new genotypes (germplasm/breeding lines/cultivars) will be screened for tolerance to herbicide imazethapyr (Pursuit: BASF). The trial will be conducted in RBD with 3 reps. Each plot will be of a single row of 2m.	This trial will be conducted at the following four locations: (1) ICRISAT-Patancheru; (2) IIPR-Kanpur; (3) IARI-New Delhi; (4) PAU-Ludhiana. ICRISAT will constitute this trial and supply seed to partners.
	HTS-3: Each center will screen available cultivars/breeding lines/germplasm (including accessions of wild species) for tolerance to herbicide imazethapyr (Pursuit: BASF). Selected lines from this trial will be screened at multi-locations in Year 2.	This activity will be carried out by all participating centers. Each center will select genotypes for screening. Thus, the number of genotypes screened will vary from center to center. ICRISAT will screen about 30 accessions of 8 annual wild <i>Cicer</i> species for herbicide tolerance.
(6) Screen for herbicide tolerance the putative herbicide tolerant genotypes selected in the previous year	HTS-2: This trial consists of 30 entries (7 germplasm accessions and 22 breeding lines/cultivars developed by ICRISAT) selected from previous herbicide tolerance screenings. This trial will have unsprayed control for comparing yield. There will be min 3 reps and plot size will be 1 row of 4m.	This trial will be conducted by all participating centers. ICRISAT will constitute this trial and supply seed to all partners.

Activity	Proposed workplan	Participating partners and target for each partner
(7) Induce mutations and screen mutant populations for herbicide tolerance	One or two (one desi and one kabuli) chickpea varieties will be mutagenized with EMS for inducing herbicide tolerant mutants.	This activity will be carried out by the following 4 centers: (1) ICRISAT-Patancheru; (2) IIPR-Kanpur; (3) IARI-New Delhi; (4) PAU-Ludhiana. Each center will treat with EMS at least one cultivar. Protocols for EMS treatment will be provided by ICRISAT.
	Screen existing TILLING/M ₂ or M ₃ populations for herbicide tolerance.	This activity will be carried out by IARI and ICRISAT. IARI will screen available TILLING populations of ICC 4958, while ICRISAT will screen available M ₂ /M ₃ populations of JG 11 and KAK 2.
(8) Targeted breeding for development of herbicide-tolerant breeding lines	Targeted breeding for developing herbicide-tolerant breeding lines will be initiated at each center. Donors will be supplied by ICRISAT and IIPR. Each center would make crosses (kabuli x kabuli and desi x desi separately) for improving selected cultivars for herbicide tolerance.	This activity will be carried out by all participating centers. Each center will make at least 4 crosses targeted for developing herbicide tolerant breeding lines.
(9) Grow breeding lines/populations for generation advancement in the off-season	Seed of breeding lines/populations would be advanced during off-season. Efforts would be made to take at least one generation in the off-season to accelerate the breeding process.	ICRISAT and IIPR will be responsible for this activity and organize off-season seed multiplication for all partners. ICRISAT will take 2 crops in the off-season (February-May in field/greenhouse at ICRISAT, and May-September in field at RARS-Hiriyur and in greenhouse at ICRISAT). IIPR will take one crop in off-season at its center in Dharwad.
(10) Prepare and submit Annual Report of Year 1	As the project started in September 2013, only Annual Report (September 2013 to 31 March 2014) will be prepared and submitted for the first year.	This activity involves all the partners. However, ICRISAT being the lead institute will coordinate preparation of the Annual Report and submit the Annual Report to NFSM by 30 April 2014.

Proceedings of the Project Pre-launch Work Planning Meeting of NFSM Project “Developing Chickpea Cultivars Suited to Mechanical Harvesting and Tolerant to Herbicides” held at JNKVV Jabalpur on 24 August 2013

The Project Coordinator Dr Pooran Gaur had a meeting with the Commissioner of Agriculture (Dr JS Sandhu) and Additional Commissioner of Agriculture (Dr DP Malik) at Krishi Bhavan, New Delhi on 20 August 2013, where indications were given for possible approval of the project subject to satisfactory revision of the proposal, addressing comments of the reviewer, the Commissioner and the Additional Commissioner of Agriculture. In anticipation of the approval of the project, the project partners decided to have a project pre-launch work planning meeting on 24 August 2013, at JNKVV Jabalpur during the Annual Group Meet of the AICRP on Chickpea. This was an excellent opportunity as most of the project partners were participating in Chickpea Group Meet. The aim of this meeting was to discuss and refine the proposed workplan for Year 1 and develop the action plan.

The project partners who participated in the meeting included Dr Pooran Gaur (ICRISAT), Dr SK Chaturvedi (IIPR), Dr Shailesh Tripathi (IARI), Dr C Bharadwaj (IARI), Dr Sarvjeet Singh (PAU), Dr Inderjit Singh (PAU), Dr Guriqbal Singh (PAU), Dr M Yasin (RAKCA, Sehore), and Dr V Jayalakshmi (RARS, Nandyal). Except for UAS-Dharwad, all participating centers were represented.



Pictures of Project Pre-launch Work Planning Meeting held at JNKVV Jabalpur on 24 August 2013

The following points emerged from the discussions:

Mechanical harvesting

- There will be three trials (MHT-1, MHT-2 and MHT-3) at IIPR, IARI, and PAU and two trials (MHT-1 and MHT-3) at ICRISAT, RAKCA-Sehore, RARS-Nandyal and UAS-Dharwad. Each trial will have different entries for northern India (IIPR, IARI and PAU) and central and southern India (RAKCA-Sehore, ICRISAT, RARS-Nandyal and UAS-Dharwad) because of the different requirements of maturity duration.
- MHT-1: It will consist of about 20 to 30 breeding lines with appropriate checks (e.g. tall cultivar HC 5 and one or two high yielding cultivars). Each plot will have 3-4 rows and there will be min 3 reps. The entries will be nominated by the participating centers along with quantity of seed available.
- MHT-2: This trial will consist of about 100 breeding lines nominated by ICRISAT, IIPR, IARI and PAU. This is a preliminary yield trial with plot size of a single row and min 3 reps.
- MHT-3: This is a station trial where each participating center will evaluate its own breeding lines for which seed available is not adequate for multi-location trials. Selected entries from these station trials would be included in a multi-location trial in Year 2.
- The centers are encouraged to conduct one agronomy trial on HC 5 and 2-3 selected entries, if seed quantity available is adequate.
- Targeted breeding for developing tall and upright breeding lines should be initiated at each center. Donors will be supplied by ICRISAT and IIPR. Each center should attempt a minimum of 4 crosses (kabuli x kabuli and desi x desi separately) for improving selected cultivars for plant height and growth habit. Efforts should be made to take at least one generation in the off-season to accelerate the breeding process.
- Functional testing of at least 2 selected harvesting machines should be performed at PAU.

Herbicide tolerance

- There will be three trials on herbicide tolerance screening (HTS-1, HTS-2 and HTS-3) at ICRISAT, IIPR, IARI and PAU and two trials at RAKCA-Sehore, RARS-Nandyal and UAS-Dharwad.
- HTS-1: ICRISAT will constitute a trial of 300 genotypes (new germplasm/breeding lines/cultivars) and supply seed to IIPR, IARI and PAU. Each plot will be of a single row (2m) with 3 reps.
- HTS-2: This trial will have 30 entries selected from previous screenings and conducted at all 7 locations. This trial will have unsprayed control for comparing yield. There will be min 3 reps and plot size will depend on availability of seed. Seed will be sourced from ICRISAT, IIPR, IARI and PAU.
- HTS-3: Each center will screen available cultivars/breeding lines/germplasm (including accessions of wild species). Selected lines from this trial will be screened at multi-locations in Year 2.
- The TILLING population of ICC 4958 may also be screened for herbicide tolerance (IARI).

- One or two (one desi and one kabuli) chickpea varieties should be mutagenized with EMS (protocol for EMS treatment available with ICRISAT) at ICRISAT, IIPR, IARI and PAU.
- ICRISAT will screen available M2 seed of JG 11 and KAK 2 for herbicide tolerance.
- Targeted breeding for developing herbicide tolerant breeding lines should be initiated at each center. Donors will be supplied by ICRISAT and IIPR. Each center should attempt a minimum of 4 crosses (kabuli x kabuli and desi x desi separately) for improving selected cultivars for herbicide tolerance. Efforts should be made to take at least one generation in the off-season to accelerate the breeding process.