# RPF - III

 **(PROFORMA FOR SUBMISSION OF FINAL REPORT OF RESEARCH PROJECTS)**

 **Part - I : General Information**

**800 Project Code :** 101

8001 Institute Project Code No. : : 101-3

8002 ICAR Project Code No. :

**801 Name of the Institute and Division :** Directorate of Oilseeds Research, Crop Improvement Section

8011 Name & Address of the Institute : Directorate of Oilseeds Research, Rajendranagar, Hyderabad- 500 030

8012 Name of the Division/Section : Crop Improvement Section

8013 Location of the Project : Narkhoda Farm

**802 Project Title :** Diversification of parental base and development of elite lines, populations, varieties and hybrids in sunflower

**803 Priority Area :** Heterosis breeding, population improvement

2031 Research Approach : AppliedRes./ BasicRes./ Process Dev/ Tech. transfer

 01 (Y) 02 03 04

**804 Specific Area :** Sunflower Breeding

**805 Duration of the Project :** 2008-2013

8051 Date of Start : 2008

8052 Date of Completion : 2013

**806 Total Cost/Expenditure Incurred:** Rs 1, 20, 04,000/5years (No variation)

 (Give reasons for variation, if any, from the original estimated cost)

**807 Executive Summary :** 500 new cross combinations were made from 2009-2012 and evaluated for yield and SND tolerance at field level.100 new hybrids were synthesized using 20 CMS and 5 restorer lines. These hybrids were evaluated along with check during *kharif* 2009 to identify superior hybrids for seed yield and other agronomic characters. During *rabi* 2008-09, 100 new hybrids were synthesized using 20 CMS and 5 restorer lines. The best identified hybrids from 2008-09 and newly developed hybrids were evaluated together along with check during *kharif* 2010 to identify superior hybrids for seed yield and other agronomic characters. In F5 generation during 2012 four crosses were identified showing lesser than 25 % of disease incidence in in-vitro screening for SND tolerance where as Mordern had recorded 100 % susceptible reaction to SND. These two tolerant to SND prebred lines could be seen as potential tolerant lines for SND. Using seven CMS lines *viz*., CMS 234A, CMS 17A, CMS 852A, CMS 89A, ARM 238A, ARM 243A and ARM 248A and six inbred lines *viz*., RES-834-1, LTRR 341, RHA-6D-1R, 3376R, R-298 and R-649 crossing was performed in line\ x tester fashion to produce 42 hybrids. During *rabi*, 2009-10 the 42 hybrids along with their parents and three standard checks *viz*., KBSH-1, PAC-1091 and KBSH-44 were evaluated in a Randomized Block Design replicated thrice at three different locations *viz*., Directorate of Oilseeds Research, Hyderabad; Agricultural Research Station, Tandur; and Regional Agricultural Research Station, Jagtial. Observations were recorded on five randomly selected plants in each hybrid combination per replication for nine quantitative characters. Pool mean performance of parents and hybrids for different yield and yield components is presented in table 1. A total of 300 new crosses were synthesized during the year *rabi* 2011-12. 30 testers were used in the crossing programme against pet 2 derived 10 CMS lines.

**208 Key Words:** Hybrids, Seed yield and oil content

**Part - II Investigator Profile**

**810 Principal Investigator :**

8101 Name : Dr. Mangesh Y. Dudhe

8102 Designation : Scientist

8103 Division/Section : Crop Improvement

8104 Location : DOR, Hyderabad

8105 Institute Address : Directorate of Oilseeds Research, Rajendranagar, Hyderabad- 500 030

**811 Co-investigator :**

8111 Name : Dr. H. P. Meena

8112 Designation : Scientist

8113 Division/Section : Crop Improvement

8114 Location : DOR, Hyderabad

8115 Institute Address : Directorate of Oilseeds Research, Rajendranagar, Hyderabad- 500 030

**812 Co-investigator :**

8121 Name : Dr. Sudhakar Babu

8122 Designation : Principal Scientist

8123 Division/Section : Crop Production

8124 Location : DOR, Hyderabad

8125 Institute Address : Directorate of Oilseeds Research, Rajendranagar, Hyderabad- 500 030

**813 Co-investigator :**

8131 Name : Dr. H. Basappa

8132 Designation : Principal Scientist

8133 Division/Section : Crop Protection

8134 Location : DOR, Hyderabad

8135 Institute Address : Directorate of Oilseeds Research, Rajendranagar, Hyderabad- 500 030

 **814 Co-investigator :**

8136 Name : Dr. Chander Rao

8137 Designation : Principal Scientist

8138 Division/Section : Crop Protection

8139 Location : DOR, Hyderabad

8140 Institute Address : Directorate of Oilseeds Research, Rajendranagar, Hyderabad- 500 030

 **815 Co-investigator :**

8141 Name : Dr. I.Y.L.N. Murthy

8142 Designation : Principal Scientist

8143 Division/Section : Agril. Chemistry

8144 Location : DOR, Hyderabad

8145 Institute Address : Directorate of Oilseeds Research, Rajendranagar, Hyderabad- 500 030

**816 Co-investigator :**

8146 Name : M. Santha Lakshmi

8147 Designation : Principal Scientist

8148 Division/Section : Crop Protection

8149 Location : DOR, Hyderabad

8150 Institute Address : Directorate of Oilseeds Research, Rajendranagar, Hyderabad- 500 030

**Part - III : Technical Details**

**820 Introduction and objectives :** Sunflower (*Helianthus annuus* L.) is one of the most important edible oilseed crops, which ranks next to soybean in the worlds production of edible oils. Sunflower has become the fourth most important oilseed crop of India occupying an area of about 2 million hectares. The basic chromosome number for the *Helianthus* genus is 17 (2n=2x=34). Diploid, tetraploid and hexaploid species are known. The majority of the species are perennial with only about a dozen annual species. Plant breeders have made interspecific crosses within the genus and have transferred such useful characters as higher oil percentage, cytoplasmic male sterility for use in production of hybrids, and disease and insect resistance to commercial sunflower. The discovery of cytoplamic male sterility and subsequent identification of restorers have significantly contributed in genetic improvement of the crop as well as in exploitation of heterosis, leading to development and release of several hybrids for commercial cultivation. Ever since the release of first sunflower hybrid in India BSH-1 and many hybrids have been released for commercial cultivation. The importance of heterosis breeding and value of indigeneous hybrids in sunflower were recognised after the inclusion of sunflower under AICRP and testing of experimental hybrids started as early as 1975 in India. Later on, many new hybrids have been released for cultivation in India for commercial cultivation through heterosis breeding*.*

 Diversification of CMS and restorer line is inevitable in heterosis breeding programmes as the use of single CMS source involves a potential risk if it becomes susceptible to a new strain of diseases. Hence, efforts are required to diversify the restorer base along with the cytoplasmic base in sunflower. The major diseases limiting sunflower cultivation in India are necrosis, powdery mildew, *Alterneria* leaf spot, downey mildew, and rust disease. The disease Sunflower Necrosis was first recorded in parts of Karnataka state in 1997.In India it regularly occurs in Andhra Pradesh, Karnataka, Maharashtra, and Tamil Nadu.Causal organism is Virus particularly Tospovirus. This disease occurs more in *kharif*, Moderate in *rabi* and High in summer sown crops. The disease was observed at all growth stages of the crop (seedling to maturity). Field symptoms of the disease include extensive necrosis of leaf lamina, petiole, stem and floral calyx and severe stunting with malformation of flowering head when plants are infected early. SND affect up to 80% yield losses in sunflower have been released.

Thus systemic breeding programme is essential to identify and develop superior hybrids which are resistant for sunflower necrosis disease. Keeping in view of the above mentioned aspects, a research project titled ‘Diversification of parental base and development of elite lines, populations, varieties and hybrids in sunflower’ will be undertaken with the following objectives

1. Development of necrosis resistant genotypes in sunflower
2. Development of prebred lines against SND
3. Development of high yield, oil and resistant CMS and R lines and Hybrids in sunflower
4. Development of high yield, oil and resistant F1 hybrids for SND

8201 Project Objectives :

1. Development of necrosis resistant genotypes in sunflower
2. Development of prebred lines against SND
3. Development of high yield, oil and resistant CMS and R lines and hybrids in sunflower
4. Development of high yield, oil and resistant F1 hybrids for SNA

8202 Background Information and Importance of the Project :

Diversification of CMS and restorer line is inevitable in heterosis breeding programmes as the use of single CMS source involves a potential risk if it becomes susceptible to a new strain of diseases. Hence, efforts are required to diversify the restorer base along with the cytoplasmic base in sunflower. The major diseases limiting sunflower cultivation in India are necrosis, powdery mildew, *Alterneria* leaf spot, downey mildew, and rust disease. The disease Sunflower Necrosis was first recorded in parts of Karnataka state in 1997.In India it regularly occurs in Andhra Pradesh, Karnataka, Maharashtra, and Tamil Nadu. Causal organism is Virus particularly Tospovirus. This disease occurs more in *kharif*, Moderate in *rabi* and High in summer sown crops. The disease was observed at all growth stages of the crop (seedling to maturity). Thus systemic breeding programme is essential to identify and develop superior hybrids which are resistant for sunflower necrosis disease. Keeping in view of the above mentioned aspects, a research project titled ‘Diversification of parental base and development of elite lines, populations, varieties and hybrids in sunflower’ will be undertaken

**821 Project Technical Profile :**

8211 Technical Programme :

 (Indicate briefly plan of procedure, techniques, instruments and special materials,

 organisms, special environments, etc.)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Activity** | **Scientists involved** | **Year** |  |  |  |  |  |
|  |  | **I** | **II** | **III** | IV | V | VI |
|  Development of resistant F1 hybrids for SND | Mangesh Dudhe | **xxx** |  | **xxx** |  |  |  |
|  Evaluation of F1 Hybrids | Mangesh Dudhe | **xxx** |  | **xxx** |  |  |  |
| Maintaince of CMS lines | Mangesh Dudhe | **xxx** | **xxx** | **xxx** | **xxx** | **xxx** | **xxx** |
| Inbred development | Mangesh Dudhe | **xxx** | **xxx** | **xxx** | **xxx** | **xxx** | **xxx** |
| Seed multiplication of genetic stocks | Mangesh Dudhe | **xxx** |  | **xxx** |  | **xxx** | **xxx** |
| Maintenance breeding and nucleus seed production | Mangesh Dudhe | **xxx** | **xxx** | **xxx** | **xxx** | **xxx** | **xxx** |
| Development of diverse CMS and R lines | Mangesh Dudhe | **xxx** | **xxx** | **xxx** | **xxx** | **xxx** | **xxx** |
| Evaluation of crosses for B/R reaction | Mangesh Dudhe | **xxx** |  | **xxx** |  | **xxx** | **xxx** |
| Maintenance of restorer lines | Mangesh Dudhe | **xxx** |  | **xxx** |  | **xxx** | **xxx** |
| Invitro screening of the genotypes for SND resistance and Alterneria | Dr. Chander Rao and Dr. M. Santha Lakshmi | **xxx** | **xxx** |  | **xxx** | **xxx** | **xxx** |
| Screening of the genotypes for insect pest resistance | Dr. H. Basappa |  |  |  | **xxx** | **xxx** | **xxx** |
| Screening of the genotypes for fatty acid profile | Dr. I.Y.L.N. Murthy |  |  |  | **xxx** | **xxx** | **xxx** |
| Evaluation of the newly **,** developed populations, varieties and hybrids withagronomical practices | Dr.S.N.Sudhakara Babu |  |  |  | **xxx** | **xxx** | **xxx** |

8212 Total Man-months Involvement of Component Project Workers :

a) Scientific - Scientist (s) (Man Months/5 yr.)

 Dr. Mangesh Y.Dudhe : 60 months

 Dr. Chander Rao : 8 months

 Dr. I.Y.L.N. Murthy : 2 months

 Dr. H. Basappa : 3 months

 Dr. M. Santha Lakshmi : 3 months

 Dr.S.N.Sudhakara Babu : 3 months

 b) Technical (Man Months/3 yr.)

 Crop protection (12 months/yr.) : 60 months

 c) Supporting (Man days/ 5years)

 Skilled helper – Crop protection - for 400 days/yr. : 1500 days

**822 Final Report on the Project** :

 Detailed report containing all relevant data with a summary of results (Not

 exceeding 2-5 pages)

**Objective I: Development of necrosis resistant genotypes in sunflower**

Based on field scorning results obtained during 2008 for the CMS and inbred lines, the lines showing less than 25 % of incidence to SND were selected for generation of crosses. 100 new hybrids were synthesized using 20 CMS and 5 restorer lines. These hybrids were evaluated along with check during kharif 2009 to identify superior hybrids for seed yield and other agronomic characters. During rabi 2008-09, 100 new hybrids were synthesized using 20 CMS and 5 restorer lines (Table1). The best identified hybrids from 2008-09 and newly developed hybrids were evaluated together along with check during kharif 2010 to identify superior hybrids for seed yield and other agronomic characters. 2 cross combinations ACS01/DRM-34-2 x EC 602060 and NDCMS-1A x EC 602060 which also reported for high yield (43 g/plant) with less incidence of necrosis were selected for the development of nerosis resistance genotypes. Continuous selfing and selection procedure adapted during 2010 and 2011 from fertile plant with minimum incidence of necrosis for each year for the development of nerosis resistant genotypes.

**Objective2: Development of prebred lines against SND**

For SND and Alterneria no resistance sources are available hence development of prebred lines for SND tolerance by using two wild species (H. *maximiliani and H. occidentalis*) under elite background of H. *annuus* is started during 2009-10. Generation advancement of the 21 hybrids was carried out in the rabi 2011-12. 23 interspecific derivatives (F4) which were identified were screened in-vitro for SND tolerance by DAS-ELISA standard. Two advanced crosses showed less incidence of SND under in-vitro condition (<40-50%). Two advanced crosses EC601784xMax1631 (F4) and M55xocc52 (BC1F4) showed less incidence of SND under in-vitro condition (<25%) where as modern (check) showed 100 % incidence of SND. These four tolerant to SND prebred lines could be seen as potential tolerant lines for SND. Also there is need to screen for all the advanced 180 prebred lines for SND tolerance. The identified crosses were advanced in field conditions during 2012-13. Under the field condition few plants from the F5’s, F6’s and BC1F6 showed tolerance to SND. A set of advanced 50 interspecific derivatives were handed over to pathologist for *in vitro* screening of the SND tolerance.

**Objective 3: Development of high yield, oil and resistant CMS and R lines and Hybrids in sunflower**

Using seven CMS lines viz., CMS 234A, CMS 17A, CMS 852A, CMS 89A, ARM 238A, ARM 243A and ARM 248A and six inbred lines viz., RES-834-1, LTRR 341, RHA-6D-1R, 3376R, R-298 and R-649 crossing was performed in line\ x tester fashion to produce 42 hybrids. During rabi, 2009-10 the 42 hybrids along with their parents and three standard checks viz., KBSH-1, PAC-1091 and KBSH-44 were evaluated in a Randomized Block Design replicated thrice at three different locations viz., Directorate of Oilseeds Research, Hyderabad; Agricultural Research Station, Tandur; and Regional Agricultural Research Station, Jagtial. Observations were recorded on five randomly selected plants in each hybrid combination per replication for nine quantitative characters. Pool mean performance of parents and hybrids for different yield and yield components is presented in table 1. A total of 300 new crosses were synthesized during the year rabi 2011-12.

**Table 1. Performance of top ranking new hybrids in evaluation trial (DOR Hyderabad, 2009)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S.****No** |  **Entry** | **Days to 50 % flowering** | **Days****to maturity** | **Plant height****( cm)** | **Head****diameter** **( cm)** | **Seed yield****(g /plant)** | **100 Seed weight****(g)** | **Oil****content** **(%)** |
| 1 | CMS378A/M-1008 x Ec512698 | 53.3 | 82.7 | 159.0 | 15.9 | 33.3 | 5.8 | 35.4 |
| 2 | ACS01/DRM-34-2 x EC 602060 | 54.3 | 85.0 | 153.0 | 15.2 | **43.0** | 5.0 | 35.8 |
| 3 | IMS/M1008 x EC602055 | 53.0 | 86.0 | 166.3 | 15.2 | 33.1 | 6.0 | 37.6 |
| 4 | ACS-01/DRM34-2 x EC512698 | 54.0 | 85.0 | 164.7 | 14.9 | 41.5 | 5.3 | 33.6 |
| 5 | CMS234A x EC602025 | 54.0 | 84.7 | 142.0 | 14.2 | 40.1 | 4.8 | 35.6 |
| 6 | GIG1/7-1B x EC 512698 | 56.7 | 85.7 | 155.7 | 15.5 | 34.3 | 5.4 | 35.3 |
| 7 | FMS/M1024x EC 602060 | 55.7 | 86.0 | 164.0 | 14.1 | 32.7 | 6.5 | 36.9 |
| 8 | FMS/M-1024 x 6D1 | 55.0 | 85.7 | 174.0 | 15.2 | 28.7 | 4.9 | **38.2** |
| 9 | PET2/NDOL-2 x EC 602060 | 58.3 | 84.8 | 161.7 | 15.5 | 36.3 | 7.0 | 36.0 |
| 10 | GIG1/7-1B x EC 512698 | 58.3 | 87.3 | 166.7 | 15.3 | 39.2 | 6.6 | 36.4 |
| 11 | GIG1/7-1B x EC 602060 | 56.0 | 85.3 | 152.0 | 14.5 | 33.1 | 5.9 | 37.9 |
| 12 | CMS302A x EC 512698 | 56.0 | 83.8 | 140.0 | 14.7 | 33.7 | 6.2 | 36.3 |
| 13 | NDCMS-1A x EC 602060 | 54.0 | 85.3 | 155.0 | 14.6 | **43.01** | 6.9 | 34.6 |
|  | KBSH-44 © | 59.0 | 88.0 | 191.0 | 13.4 | 32.3 | 4.7 | 38.3 |
|  | KBSH-1 © | 55.0 | 83.8 | 184.0 | 14.7 | 37.5 | 5.2 | 36.2 |
|  | PAC-1091 © | 56.7 | 85.3 | 147.3 | 15.3 | 39.4 | 5.6 | 34.1 |
|  | SE m + | 1.4 | 1.2 | 8.7 | 1.2 | 4.25 | 0.6 | 1.0 |
|  | CD (p=0.05) | 3.8 | 3.4 | 24.0 | 3.4 | 11.7 | 1.6 | 2.7 |
|  | CV (%) | 4.3 | 2.2 | 10.2 | 15.5 | 29.8 | 19.4 | 4.7 |

**Objective 4:** **Development of high yield, oil and resistant F1 hybrids for SND**

500 new cross combinations were made from 2009-2012 and evaluated for yield and SND tolerance at field level. During the year 2009, 100 hybrids were evaluated for yield and SND tolerance at field level along with different agronomic characters and identified promising hybrids.

During the year 2009, 100 hybrids were evaluated for yield and different agronomic characters and SND tolerance at field level and identified promising hybrids (Table2) and identified restorers and maintainers for different CMS sources in sunflower Table 3.

**Table 2. Performance of top ranking hybrids in evaluation trial (DOR, Hyderabad, 2010)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S.****No** |  **Entry** | **Days to 50 % flowering** | **Days****to maturity** | **Plant height****( cm)** | **Head****diameter** **( cm)** | **Seed yield****(g /plant)** | **100 seed weight****(g)** | **Oil****content** **(%)** |
| 1 | FMS/M-1013 x IB-9 | 55 | 82 | 165 | 13.5 | 31.0 | 5.6 | 36.4 |
| 2 | FMS/PARRVN-1329 x R-834-1 | 58 | 86 | 139 | 14.8 | 36.3 | 5.2 | 37.9 |
| 3 | IMS/M-1011 x LRHA-W-5 | 51 | 83 | 165 | 13.5 | 32.0 | 4.2 | 36.3 |
| 4 | IMS/M-120 x 13 R | 52 | 78 | 167 | 14.1 | 30.5 | 5.0 | 34.6 |
| 5 | IMS-852 A x RHA-1-1 | 55 | 86 | 179 | 14.4 | 35.3 | 4.8 | 36.9 |
| 6 | IMS-852 A x RHA-1-2 | 55 | 82 | 166 | 13.5 | 33.0 | 5.6 | 32.0 |
| 7 | IMS/M-269 x IB-38 | 56 | 86 | 175 | 15.2 | 28.7 | 4.9 | 37.2 |
| 8 | PET-2/89-B x CSFI-5350 | 58 | 85 | 162 | 15.5 | 36.3 | 7.0 | 36.0 |
| 9 | PET-2/R.-834-1 X HOAC1 | 58 | 87 | 167 | 15.3 | 39.2 | 6.6 | 36.4 |
| 10 | CMS-378A/M-1005 x 13R | 56 | 85 | 152 | 14.5 | 33.1 | 5.9 | 37.9 |
| 11 | G1G1/Selection-1 x CSFI-5350 | 54 | 85 | 165 | 14.9 | 41.5 | 5.3 | 33.6 |
| 12 | CMS-7-1A x R-43 | 54 | 85 | 142 | 14.2 | 40.1 | 4.8 | 35.6 |
| 13 | ACS01/DRM-34-2 x EC 602060 | 54 | 85 | 153 | 15.2 | 43.0 | 5.0 | 35.8 |
| 14 | IMS/M1008 x EC602055 | 53 | 86 | 166 | 15.2 | 33.1 | 6.0 | 37.6 |
| 15 | CMS302A x EC 512698 | 56 | 84 | 140 | 14.7 | 33.7 | 6.2 | 36.3 |
| 16 | NDCMS-1A x EC 602060 | 54 | 86 | 157 | 14.6 | 42.0 | 6.9 | 37.6 |
| 17 | KBSH-1 © | 57 | 84 | 245 | 11.6 | 33.2 | 3.8 | 38.3 |
| 18 | KBSH-44 © | 59 | 89 | 248 | 12.0 | 30.0 | 3.6 | 37.2 |
| 19 | DRSH-1© | 57 | 85 | 147 | 15.3 | 39.4 | 5.6 | 34.1 |
|  | SE m + | 1.3 | 1.3 | 7.7 | 1.2 | 4.25 | 0.6 | 1.0 |
|  | CD (P=0.05) | 3.8 | 3.4 | 22 | 2.4 | 12.7 | 1.6 | 3.7 |
|  | CV (%) | 4.3 | 3.2 | 9.2 | 15.5 | 29.8 | 17.4 | 4.7 |

**Table 3. Maintainer/restorer reaction of different inbred lines in the background of three CMS sources**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Inbred** | **PET-1** | **CMS PF** | **CMS I** |
| **ARM 243A** | **FMS 850A** | **IMS 850A** |
| 1 | RHA- 859 | R | M | M |
| 2 | RHA-6D-1R | R | M | M |
| 3 | RHA-274 | R | M | M |
| 4 | RHA-341 | R | M | M |
| 5 | PS-3035 | M | M | S |
| 6 | R-296 | M | M | M |
| 7 | P-356R | R | M | M |
| 8 | 3376R | R | M | M |
| 9 | GP-290-5-3 | M | M | R |
| 10 | PKV101R | R | M | M |
| 11 | LRHA P2 | R | M | M |
| 12 | R-17 | R | R | M |
| 13 | LTRR-5 | R | R | R |
| 14 | R-288 | R | M | M |
| 15 | NDR-7 | R | M | M |
| 16 | P-69R | R | M | M |
| 17 | NDOL-2 | M | M | M |
| 18 | 95-C1 | R | M | S |
| 19 | P-70R | R | M | M |
| 20 | R-297 | R | M | M |
| 21 | R-273 | R | M | M |
| 22 | PS-1027 | M | M | S |
| 23 | R-649 | R | M | M |
| 24 | R-356 | M | M | M |
| 25 | RES-834-1 | R | M | M |
| 26 | NDR-4 | M | M | M |
| 27 | NDLR-1 | R | M | M |
| 28 | GP1-69 | M | M | S |
| 29 | R-587 | M | M | S |
| 30 | GP-322-1 | M | M | R |
| 31 | R-271 | M | M | M |
| 32 | GP-33E-4-2 | M | M | M |
| 33 | GP-2158-4 | M | M | M |
| 34 | R-298 | R | M | M |
| 35 | GP2-2086 | M | M | M |
| 36 | GP2-1217 | M | M | M |
| 37 | GP-472-5-5 | M | M | M |
| 38 | R-272-1 | R | M | M |
| 39 | GP-2166-5 | M | M | M |
| 40 | GP-325-3 | M | M | M |
| R =Restorer; M = Maintainer; S= Segregation |

 New test hybrids were evaluated for yield and different agronomic characters and identified promising hybrids during 2011-12(Table1).

**Table 4. Mean performance of promising hybrids for different yield and yield components evaluated at three different centres**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CROSSES** | **Days to 50% flowering** | **Days** **to maturity** | **Plant height (cm)** | **Head diameter (cm)** | **Stem diameter (cm)** | **Number of filled seeds/ head** | **100 seed weight (g)** | **Seed yield /plant (g)** | **Oil content (%)** |
| CMS-234A X RHA-6D-1R | 62.00 | 93.00 | 155.43 | 12.29 | 2.01 | 889.29 | 4.30 | 37.63 | 38.00 |
| CMS-17A X RES-834-1 | 67.83 | 100.17 | 143.29 | 11.82 | 1.71 | 766.86 | 4.34 | 32.36 | 35.22 |
| CMS-17A X LTRR-341 | 61.17 | 89.83 | 140.25 | 11.33 | 1.42 | 862.66 | 4.51 | 38.06 | 33.19 |
| CMS-17A X 3376R | 66.00 | 97.67 | 146.55 | 11.83 | 1.54 | 812.51 | 4.35 | 33.39 | 34.54 |
| CMS-17A X RHA-6D-1R | 64.67 | 95.00 | 155.97 | 13.68 | 1.54 | 871.86 | 5.11 | 42.94 | 36.12 |
| CMS-852A X RHA-6D-1R | 65.33 | 96.67 | 143.83 | 13.43 | 1.76 | 861.44 | 4.41 | 37.24 | 39.23 |
| CMS-89A X RES-834-1 | 65.50 | 98.50 | 140.38 | 11.33 | 1.64 | 748.73 | 5.03 | 34.84 | 40.53 |
| CMS-89A X RHA-6D-1R | 65.33 | 96.00 | 144.50 | 11.25 | 1.57 | 839.12 | 4.42 | 35.33 | 38.64 |
| ARM-238A X RES-834-1 | 63.33 | 96.67 | 149.27 | 11.70 | 1.77 | 1089.95 | 3.39 | 36.21 | 39.85 |
| ARM-238A X 3376R | 64.67 | 96.33 | 154.52 | 12.37 | 2.10 | 936.12 | 4.00 | 36.87 | 36.72 |
| ARM-238A X RHA-6D-1R | 62.50 | 91.67 | 167.67 | 12.33 | 1.99 | 556.24 | 4.37 | 23.42 | 39.29 |
| ARM-238A X R-298 | 64.50 | 96.83 | 165.17 | 11.77 | 1.89 | 734.92 | 4.06 | 28.98 | 40.18 |
| ARM-238A X R-649 | 65.33 | 99.33 | 159.07 | 12.80 | 1.81 | 521.29 | 4.79 | 23.76 | 38.86 |
| ARM-243A X RES-834-1 | 63.33 | 92.33 | 143.07 | 11.55 | 2.01 | 722.62 | 4.18 | 29.38 | 39.98 |
| ARM-243A X LTRR-341 | 62.33 | 94.50 | 149.83 | 12.58 | 2.08 | 580.68 | 4.33 | 23.94 | 36.61 |
| ARM-243A X 3376R | 62.33 | 94.67 | 155.60 | 12.68 | 2.09 | 826.49 | 4.58 | 36.94 | 37.78 |
| ARM-243A X RHA-6D-1R | 61.50 | 91.17 | 153.68 | 13.83 | 1.90 | 707.75 | 4.98 | 34.04 | 39.62 |
| ARM-243A X R-298 | 62.17 | 91.17 | 149.92 | 13.35 | 1.96 | 814.63 | 4.62 | 35.56 | 39.49 |
| ARM-243A X R-649 | 64.17 | 94.17 | 144.46 | 13.15 | 2.09 | 534.55 | 4.79 | 24.67 | 39.29 |
| ARM-248A X RES-834-1 | 62.17 | 91.17 | 162.65 | 11.65 | 2.19 | 599.53 | 4.36 | 25.10 | 39.29 |
| ARM-248A X LTRR-341 | 61.83 | 91.83 | 170.28 | 12.47 | 1.74 | 574.09 | 4.91 | 27.12 | 35.78 |
| ARM-248A X 3376R | 64.17 | 95.17 | 148.82 | 12.98 | 1.84 | 790.53 | 3.97 | 30.48 | 38.13 |
| ARM-248A X RHA-6D-1R | 65.17 | 96.17 | 157.05 | 12.65 | 1.92 | 809.52 | 4.64 | 36.39 | 39.48 |
| Crosses mean | 63.92 | 94.76 | 146.64 | 11.89 | 1.83 | 697.44 | 4.21 | 28.36 | 37.84 |
| General mean | 64.01 | 94.80 | 142.36 | 11.41 | 1.79 | 632.39 | 4.11 | 25.34 | 37.51 |
| **Parental mean** | **64.14** | **94.63** | **126.60** | **9.48** | **1.64** | **391.64** | **3.69** | **13.60** | **36.74** |
| **KBSH-1 (c)**  | 62.67 | 93.67 | 152.85 | 13.78 | 1.89 | 719.90 | 4.34 | 31.13 | 37.37 |
| **PAC-1091 (c)** | 65.17 | 95.17 | 140.11 | 12.24 | 1.77 | 820.53 | 4.32 | 34.45 | 35.28 |
| **KBSH-44 (c)** | 66.00 | 99.67 | 159.19 | 13.22 | 1.88 | 754.31 | 5.00 | 36.65 | 35.70 |
| **SEm±** | 0.61 | 0.63 | 2.49 | 0.46 | 2.02 | 27.02 | 6.07 | 1.02 | 0.77 |
| **CD (P=0.05)** | 1.73 | 1.78 | 7.06 | 1.30 | 0.06 | 76.53 | 0.17 | 2.87 | 2.18 |
| **CV (%)** | 1.36 | 0.94 | 2.49 | 5.75 | 1.58 | 6.03 | 2.10 | 10.71 | 2.90 |

During the year *rabi* 2011-12 the following parents were selected in order to attempt the crossing programme. In this crossing progarmme already identified SND tolerant material was used as tester like ID 1-10 lines. A total of 300 new crosses were synthesized.

|  |  |  |
| --- | --- | --- |
| **S. No.** |  **CMS Lines** |  **Restorers** |
| 1 | CMS-234A | SCG-96, TSG-18, SCG-108, SCG-30, SCG-29, PS-4045, SCG-2, SCG-80, TSG-38, TSG-44, SCG-42, TSG-52, SCG-53, SCG-6, ID-7, TSG-13, TSG-53, TSG-28, TSG-22, TSG-20 RHA-1-1, RHA-274 |
| 2 | ARM-243 | SCG-96, TSG-18, SCG-108, SCG-30, SCG-29, PS-4045, SCG-2, SCG-80, TSG-38, TSG-44, SCG-42, TSG-52, SCG-53, SCG-6, ID-7, TSG-13, TSG-53, TSG-28, TSG-22, TSG-20 RHA-1-1, RHA-274, SCG-74, SCG-81, SCG-37, SCG-108, TSG-17, TSG-31, ID-33, TSG-24, TSG-20, TSG-21, RHA-464, TSG-19, TSG-12, ID-5, HA-467 |
| 3 | CMS-17A | SCG-96, TSG-18, TSG-38, TSG-44, TSG-52, TSG-13, TSG-53, TSG-22, TSG-20, RHA-274, TSG-12, SCG-51, RHA-464, SCG-51, TSG-17, TSG-24 |
| 4 | CMS-851A | SCG-96, TSG-18, TSG-29, TSG-38, TSG-44, TSG-52, SCG-42, ID-7, TSG-13, TSG-53, TSG-24, TSG-22, TSG-20 RHA-1-1, RHA-274, TSG-17, RHA-464, TSG-21, TSG-12 |
| 5 | CMS-338A | SG-26, SCG-27, TSG-54, PS-4079, SCG-102, SCG-95, SCG-96, TSG-13, TSG-22, Morden |

8221 Achievements in Terms of Targets Fixed for Each Activity : The said target was achieved i.e. the hybrids were evaluated and promising entries were identified. Also new Maintainer and Restorer were identified for the new CMS lines as per the objectives mention.

8222 Questions - Answered : -Nil-

8223 Process/Product/Technology/Developed: 23 new test hybrids were Identified as promising hybrids over 3 tested location which may be incorporated in the multilocation AICRP trial for evaluation.

8224 Practical Utility : (Not more than 150 words)

23 new test hybrids were Identified as promising hybrids over 3 tested location which may be incorporated in the multilocation AICRP trial for evaluation.

8225 Constraints, if any :- Nil-

**823 Publications and Material Development :**

 (One copy each to be supplied with this Proforma)

8231 Research Papers :

1) B. Satish Chandra1, S. Sudheer Kumar, A.R.G. Ranganatha and M.Y.Dudhe 2010. Inheritance of fertility restoration for different CMS sources in sunflower (Helianthus annuus L.) SABRAO Journalof Breeding and Genetics 42 (1) 46 – 50.

2) B. Satish Chandra1, S. Sudheer Kumar, A.R.G. Ranganatha and **M.Y.Dudhe** 2010. Inheritance of fertility restoration for different CMS sources in sunflower (*Helianthus annuus* L.) SABRAO Journalof Breeding and Genetics 42 (1) 46 – 50.

8232 Popular Articles :- Nil-

8233 Reports : Prepared AICRP breeding report of the year 2009 -10 and reported the identified hybrids. Prepared AICRP breeding report of the year 2010 and 11 and reported the identified hybrids and identified restorers and maintainers. Prepared AICRP breeding report of the year 2011 -12 and reported the identified hybrids and identified restorers and maintainers. Information pertaing this project is regularly published in DOR annual report with detail research achievement.

8234 Seminars, Conferences and Workshops (Relevant to the Project) in which the

 Scientists have Participated : (List abstracts forwarded)

Participated in the Annual AICRP, Sunflower workshop at Coimbatore, and presented the status and work done related to germplasm in workshop. Participated : Participated in the Annual AICRP, Sunflower workshop held at Akola, during 2011 and presented the status and work done related to germplasm in workshop. Participated in the Annual AICRP, Sunflower workshop held at Banglore, during 2011 and presented the status and work done related to germplasm in workshop.

**824 Infrastructural Facilities Developed** :- Nil-

 (Details of field, laboratory, notebooks and final material and their location)

825 Comments/Suggestions of Project Leader regarding possible future line of work that may be taken up arising out of this Project :

 More emphasis should be given on development of SND tolerant hybrids with high oil and high yield in future along with short duration. Also there is need to screen for all the advanced 180 prebred lines developed in this project for SND tolerance.

**Part - IV : Project Expenditure**

 (Summary)

 **Year** \_\_\_\_\_\_\_\_\_\_\_\_

**830 Total Recurring Expenditure :**

8301 Salaries : (Designation with pay scale)

 Actual

 i) Scientific 98,00,000/-

 ii) Technical 16,84,000/-

 iii) Supporting 50,000/-

 iv) Wages 50,000/-

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Sub-total 11,584,000

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8302 Consumables :

 i) Chemicals 50, 000 /-

 ii) Glasswares 50,000 /-

 iii) Others 10,000 /-

 -------------------------------------

 Sub-total

 -------------------------------------

8303 Travel : 3,00,000/-

8304 Miscellaneous : -Nil-

 (Other costs)

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8305 Sub-total 410000/-

 (Recurring) -------------------------------------

**831 Non-recurring Expenditure :-Nil-**

 (Equipment and works)

 i)

 ii)

 iii)

 ------------------------------------

**832 Total** Rs.  **1, 20, 04,000/5years**

 (830 and 831) ------------------------------------

 **Part - V : DECLARATION**

This is to certify that the final report of the Project has been submitted in full consultation with the Project Workers as per the approved objectives and technical programme and the relevant records, notebooks and materials are available for the same.

**Signature of the Project Investigator :**

**Co-investigators :**

**Co-Principal Investigators :**

**(H.P. Meena):**

 **(I.Y.L.N. Murthy):**

( **S.N.Sudhakara Babu** ):

 (**Chander Rao**):

 **(H. Basappa**):

 **( M. Santha Lakshmi):**

**Signature & Comments of the Head**

**of the Division/Section :**

**Signature & Comments of the**

**Joint Director (Research) :**

**Signature & Comments of the**

**Director :**