**ANNEXURE - V**

**INDIAN COUNCIL OF AGRICULTURAL RESEARCH**

**RESEARCH PROJECT PROFORMA FOR MONITORING ANNUAL PROGRESS (RPP- II)**

**(Refer for Guidelines ANNEXURE-XI (E))**

1. Institute Project Code : IIOR 103-13
2. Project Title: **Development of high oil yielding castor hybrids resistant to Fusarium wilt, leaf hopper and drought**
3. Reporting Period: 2015-16
4. Project Duration: Date of Start -  **July 2015**  LikelyDate of Completion–September 2020
5. Project Team (Name(s) and designation of PI, CC-PI and all project Co-PIs, (with time spent for the project) if any additions/deletions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S. No. | Name, designation and institute | Status in the project (PI/CC-PI/ Co-PI) | Time spent (%) | Work components assigned to individual scientist |
| 1. | C. Lavanya,  Principal Scientist  (Plant Breeding)  ICAR-IIOR | PI | 50 | * To develop wilt and leafhopper resistant pistillate lines with good combining ability using recombination breeding techniques * To develop early duration hybrids (<100 DAS) * To develop hybrids suitable for *rabi* and rice fallows |
| 2. | S. Senthilvel  Senior Scientist  (Plant Breeding)  ICAR-IIOR | Co-PI | 30 | * To develop wilt resistant and *Botrytis* tolerant/resistant male lines with good combining ability |
| 3 | T. Manjunatha  Scientist (Plant Breeding)  ICAR-IIOR | Co-PI | 50 | * To develop wilt and leafhopper resistant monoecious / male lines with good combining ability, high oil and ricinoleic acid * Early / medium duration, drought tolerant hybrids for rainfed conditions |
| 4 | K. T. Ramya  Scientist (Plant Breeding)  ICAR-IIOR | Co-PI | 50 | * To identify diverse sources and develop wilt and leafhopper resistant pistillate lines with good combining ability using recombination breeding techniques * To develop medium /late duration hybrids for irrigated conditions (Haryana and Rajasthan) |
| 5 | P. Lakshmamma  Principal Scientist  (Plant Physiology)  ICAR-IIOR | Co-PI | 30 | * To identify / develop plant types suitable for rabi season and mechanical harvesting * To identify diverse sources for pistillate conversion |
| 6 | M. Lakshminarayana  Principal Scientist  (Entomology)  ICAR-IIOR | Co-PI | 10 | * To identify sources of resistance to sucking pests and capsule borer among advanced selections and hybrids |
| 7 | M. Santhalakshmi Prasad  Principal Scientist  (Plant Pathology)  ICAR-IIOR | Co-PI | 15 | * To identify sources of wilt resistance among elite parental lines and hybrids |

1. (a) Activities and outputs earmarked for the year (as per activities schedule given in RPP-I)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Objective wise | Activity | Scientist responsible | % of activity envisaged to be completed as per RPP-I | % achieved as targeted |
| To identify diverse sources and develop wilt and leafhopper resistant pistillate lines with good combining ability using recombination breeding techniques | * Selection, multiplication of parents * Selection and generation advancement of intergeneric crosses * Evaluation of three new crosses for sex expression * Evaluation of new pistillate lines | C. Lavanya  K.T. Ramya  K.T. Ramya  K.T. Ramya | 50  50  50  50 | 100  100  50  100 |
|  | * Identification of new pistillate sources with high HI and high TDM | P. Lakshmamma | 25 | 100 |
| To develop wilt and leaf hopper resistant, early, medium, late duration varieties and hybrids suitable for early, late *kharif* and *rabi* seasons in traditional and non-traditional castor growing states of the country | * Selection and generation advancement of 4 double crosses and 25 single crosses for male line development | C. Lavanya | 50 | 100 |
|  | Evaluation of 81 pre-bred monoecious (PMC) lines for their yield and combining ability | T. Manjunath | 50 | 100 |
|  | Evaluation of farmers collection for their yield potential | K.T. Ramya | 50 | 100 |
|  | Introgression of wilt resistance into elite inbred lines  * Evaluation of the training set (300 inbred lines) for yield and its component traits to develop a model for estimating breeding value based on marker genotypes | S. Senthilvel | 25 | 100 |
|  | * Generation of hybrids for combining ability studies involving wilt and leafhopper resistant parents | K.T, Ramya  T. Manunatha | 25  25 | 100  100 |
| Development of early maturing hybrids for mechanical harvesting (90-100 days) | * Identification of parents for early vigor and high TDM | P. Lakshmamma | 25 | 100 |
|  | * Generation of early duration hybrids | C. Lavanya | 25 | 100 |
| To identify sources of resistance to sucking pests and capsule borer among advanced selections and hybrids | Evaluation of advanced selections and hybrids for resistance to sucking pests and capsule borer | M. Lakshminarayana | 25 | 100 |
| To identify sources of wilt resistance among elite parental lines and hybrids | Screening of elite parental lines and preliminary hybrids for wilt resistance in wilt sick plot and under glasshouse | M. Santhalakshmi Prasad | 25 | 100 |

(b) If shortfall/addition, reasons for the same and how to catch up with the intended activities: No shortfall

1. Annual Progress Report (research results and achievements in bullets):

**Research Results of the Project:**

**7.1. To identify diverse sources and develop wilt and leafhopper resistant pistillate lines with good combining ability using recombination breeding techniques:**

**7.1.1. New crossing programme (K.T. Ramya)**: A new pistillate source “Kh-13-154” is used as a donor to create diversity in pistillate trait using DPC-9 and DPC-19 as recipients. F1 s will be further used to generate back cross populations. Eight parents with desirable plant type, morphological characters were used to generate four F1s so as to accumulate favorable alleles for pistillate trait. F1s from each cross will be further inter crossed subsequently and generation is advanced to develop a stable pistillate population.

Single crosses developed

DPC 25 (Dwarf, R3Sp) x Rb 13-1854(R2Sp)

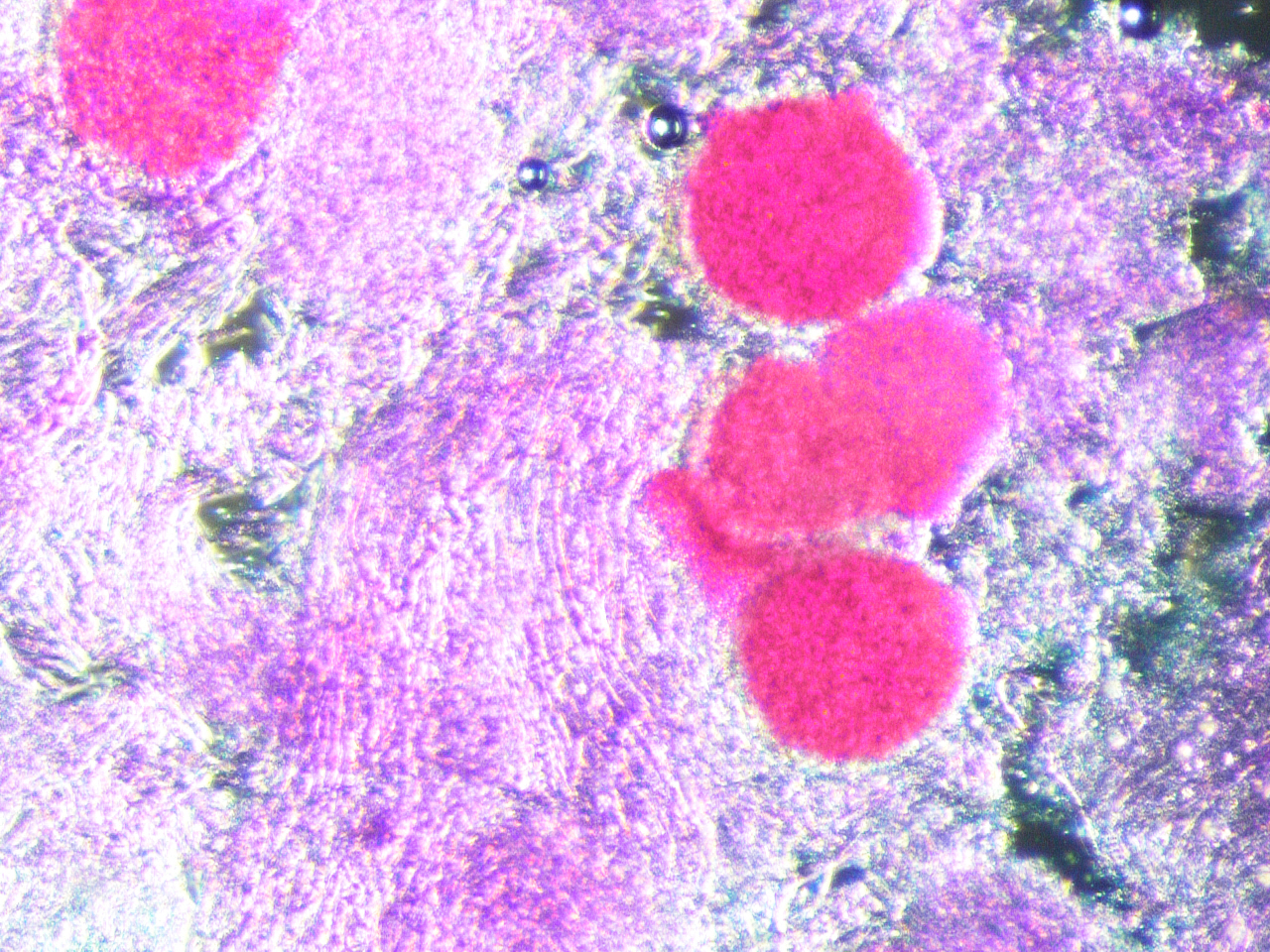
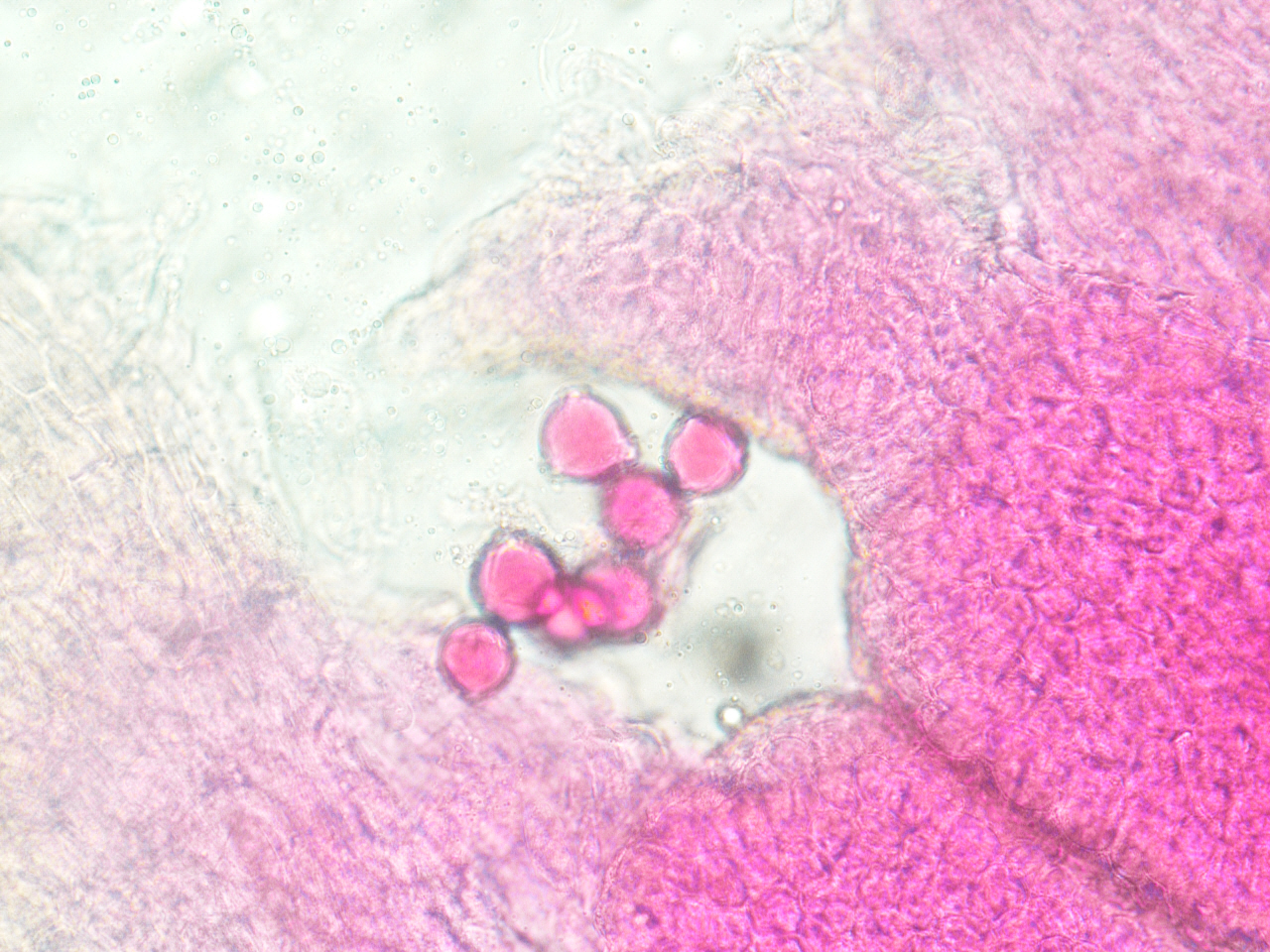
CNES-1 (R0NSp) x NES-6 (R2NSp)

M-619 (Dwarf, G3SP) x DPC-9 (G0SP)

JP-77-1 (G1SP) x DPC-21 (G2SP)

**7.1.2. Selection and generation advancement of intergeneric crosses:** 8 crosses of Tapioca x castor, 3 crosses of Jatropha x castor, 5 crosses of castor x Tapioca, 7 crosses of castor x Jatropha were further advanced. Sixteen plants out of 26 Tapioca x castor F1 seeds and 4 plants of out of 17 Jatropha x castor F1 seeds survived and continued. Pollen sterility studies were conducted

**Fig. 1. Pollen germination studies in intergeneric crosses**



Tapioca x Tapioca 18 hours after pollination Tapioca x Castor 18 hours after pollination

**7.1.3. Selection and generation advancement for pistillate trait (C. Lavanya)**: Single plant selections from 61 crosses in different segregating generations (F3 to F6) were under evaluation for pistillate traits. These 61 crosses were made to develop stable pistillate lines with diversified source involving 12 germplasm lines, farmer’s varieties and 5 high yielding lines from other breeders. In addition, single plant selections from two double cross populations, generated in 2012 rabi were further advanced for their morphological characters and sex expression. 29 progenies of three crosses generated from BC2F9 were further selected and advanced. 109 single plant selections from 17 cross combinations in F9 to F11, 120 selections in F3 from two double crosses, 75 selections from 10 back cross combinations in F9-F16 were advanced based on their pistillate trait.

Three pistillate lines *viz*., DPC-21, DPC-25 and M-571 evaluated in three coordinated centres confirmed their wilt and leafhopper resistance for two years. Among them, DPC-21 and M-571, confirmed for their combining ability for seed yield, primary spike length and late duration will be further registered as pistillate lines.

**7.2. To develop wilt and leaf hopper resistant, early, medium, late duration varieties and hybrids suitable for early, late *kharif* and *rabi* seasons in traditional and non-traditional castor growing states of the country**

**7.2.1. New variety DCS-107 (C. Lavanya)**: A CVRC released castor variety in 2011 is registered as a new plant variety by PPV & FRA with an exclusive right to produce, sell, market, distribute, import or export the variety for initial term of 6 years and renewable for the remaining years from the 27th day of April, 2015. Registration No.123 of 2015, Date of Grant: 27th April, 2015

**7.2.2. Development of wilt, leafhopper resistant monoecious male lines with good combining ability, high oil and ricinoleic acid (C. Lavanya).** Selection and generation advancement involving 25 single cross and 4 double cross combinations were advanced. 46 single plant selections in F7-F8 while 70 selections in F3 were made.

**7.2.3. Evaluation of advanced and PMC lines (T. Manjunatha):** Twenty advance lines which were stable after at F7 generation onwards were selected and were grouped as pre-bred monoecious lines. These lines were evaluated for yield and yield attributing characters and wilt resistance. Among 20 lines only one was non spiny with double bloom green stem rest were spiny types. Plant height ranged from 86 to 136 cm, with an average of 114 cm. Effective spike length ranged from 31 to 56 cm with an average of 39.5 cm. The average yield per plot was 1.3 kg/plot ranging from 0.7 to 1.75 kg/plot under rainfed conditions. These lines were also tested at wilt sick plot and 12 lines were resistant for wilt. These lines were utilized to develop hybrids using known pistillate lines, M-574, DPC-9, M-619, SKP-84 and DPC-9 in line x tester mating design to study the combining ability.

In addition, 81 PMC lines and 3 checks (DCS-9, DCS-107 & 48-1) were evaluated in an ARBD design. There was variation in initial vigour, bloom, canopy type, branching pattern, days to 50% flowering, susceptibility to pests and diseases etc. Statistical analysis revealed that there was significant variation for node number to primary spike, primary spike length, plant height, final per plant seed yield at 120 days and seed test weight (100 seeds). The PMC lines which yielded > 101 grams/plant were PMC-50, PMC-19, PMC-53, PMC-17, PMC-21, PMC-24, PMC-28, PMC-20, PMC-54, PMC-58, PMC-18, PMC-31 and PMC-52. All the breeding trials and seed production fields witnessed severe incidence of Spodoptera litura, and moisture stress which in turn affected the evaluation of trials.

**7.2.4. Identification of physiologically efficient genotypes for early vigor and high total dry matter (P. Lakshmamma):** A total of 17 genotypes which include male lines, pistillate lines and preliminary hybrids along with 48-1, DCH-519 as checks were sown during *kharif*, 2015 to select genotypes with early vigor, high TDM, seed yield and HI. Seedling dry weight at 15 DAS was positively correlated with 100 seed weight (seed size) before sowing (0.46) and with TDM at 35 DAS. TDM at 35 DAS showed strong correlation with TDM at harvest (0.543), seed yield (0.536). Genotypes with bold seed size, early vigor, TDM at 35 DAS, TDM at harvest, total seed yield, HI are identified. Among them, pistillate lines like DPC-9, DPC-21 and male lines viz., DCS-105, DCS-107, DCS-119 with bold seed size (30.3-37.8 g/100 seeds), early vigour (0.45-0.58 g/pl) will be further tested for their combining ability for specific traits. In addition, based on high seed yield (100-153 g/plant) and high HI (30-39.6%), pistillate lines like DPC-21, M-571 and male lines like DCS-107, DCS-9, 48-1, DCS-78, DCS-119 are promising for generation of hybrids (Table 1).

**Table 1: Physiologically efficient genotypes for different characters (2015-16)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Character | Range | Pistillate lines | Male lines | Hybrids |
| Bold seed size  (g/100 seeds) | 30.3-37.8 | DPC-9,DPC-21 | DCS-105,DCS-107, DCS-119 |  |
| Early vigor (g/pl) | 0.45-0.58 | DPC-9,DPC-21 | DCS-9,DCS-105,  48-1,DCS-107,  DCS-119 | PHT-14-44 |
| High TDM at 35 DAS (g/pl) | 12.5-15.7 | DPC-21,M-571, | DCS-78, DCS-107,  DCS-119, 48-1 | PHT-14-44  DCH-519 |
| High TDM at harvest (g/pl) | 300-470 | DPC-9,DPC-19,  DPC-21,M-571, | DCS-78,DCS-105,  DCS-107,DCS-119,  48-1 | DCH-519,  DCH-1715,  DCH-1720 |
| High seed yield (g/plant) | 100-153 | DPC-9,DPC-21  M-571 | DCS-107,DCS-119  48-1 | DCH-177,  DCH-1715,  DCH-1720,  PHT-14-44 |
| High Harvest Index (%) | 30.0-39.6 | DPC-9,M-571,  M-574 | DCS-9,DCS-78,48-1 | DCH-177,  DCH-1715,  DCH-1720  PHT-14-44 |

Genotypes with good seed size showed early vigor while only few genotypes maintained high TDM at 35 DAS. Among them, DPC-9, DCS-107, DCS-119 and 48-1 recorded high TDM at harvest and high seed yield. But, only DPC-9 (32.3%) and 48-1 (39.6%) recorded high HI also which shows the need for increasing the partitioning efficiency of DCS-107 and DCS-119 etc.

Based on the last 3-4 years data, 66 genotypes were statistically analyzed and ranked for 6 characters every year viz., seed size, early vigor, TDM at 35 DAS, TDM at harvest, seed yield/pl and HI and the top 15 genotypes for the last four years are listed below (Table 2).

**Table 2: Promising 15 genotypes based on early vigour, TDM and HI (2012-2015)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rank** | **2012-13** | **2013-14** | **2014-15** | **2015-16** | **Best lines** |
| 1 | CH-1 | DCS-108 | DCS-86 | 48-1 | DCS-78 |
| 2 | Sowbhagya | DCS-118 | 48-1 | DCS-119 | DCS-105 |
| 3 | DCS-97 | DPC-17 | DCH-1715 | DPC-21 | DCS-107 |
| 4 | DPC-21 | M-DPC-9-1 | DCS-78 | DCS-107 | DCS-108 |
| 5 | Kranthi | DCS-117 | DCS-81 | PHT-14-44 | DCS-119 |
| 6 | DCS-108 | DCS-109 | DCS-105 | DCH-1715 | DPC-21 |
| 7 | DCS-105 | DPC-15 | DCS-107 | DPC-9 | M-574 |
| 8 | DCS-94 | DPC-16 | DPC-23 | DCH-1720 | M-571 |
| 9 | M-574 | k12-1841-1 | PHT14-19 | M-571 | DCH-1715 |
| 10 | DCS-119 | DPC-19 | PHT14-31 | DCS-105 |  |
| 11 | Bhagya | M-574 | DCS-119 | DCH-177 | 48-1 |
| 12 | DCS-78 | DCH-1551 | DPC-24 | DCS-9 | DCH-519 |
| 13 | DCS-106 | DCH-1566 | PHT-14-20 | DCH-519 |  |
| 14 | DCH-519 | M-571 | DCH-519 | DCS-78 |  |
| 15 | DCS-84 | DPC-21 | PVT1-12-2 | DPC-19 |  |

**7.2.5. Selection of castor parents with high HI:** Twenty breeding lines were evaluated to select lines with high HI during rabi 2015 with limited protective irrigations while only DCS-81 recorded tertiary seed yield. Genotypes with 42-46.7% HI include DCS-9, DCS-78, DCS-84, DCS-97, DCS-112, DCS-119, DPC-9, PVT 12-2, K12-98-3. The breeding line Kh-12-98-3 recorded highest HI of 46.7%. It has early vigor (0.81g/pl.), high TDM (230g/pl.) and good seed yield (98.4g/pl.) also. Among 66 genotypes evaluated for three years, 23 genotypes for early vigour and high HI for at least two years were identified (Table 3).

**Table 3. Promising parents selected for high HI along with seed yield\* (2012-2015)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Genotypes** | **Mean seed yield (g/pl.)** | **HI (%)** | **S.No** | **Genotypes** | **Seed yield (g/pl.)** | **HI (%)** |
| 1 | DCS-9 | 87.3 | 40.6 | 13 | DCS-108 | 77.7 | 30.6 |
| 2 | DPC-9 | 99.1 | 34.1 | 14 | DCS-89 | 139.4 | 39.8 |
| 3 | DCS-78 | 106.9 | 37.7 | 15 | K12-91-2 | 153.4 | 51.2 |
| 4 | DPC-17 | 103.5 | 36.9 | 16 | DCS-109 | 94.8 | 37.1 |
| 5 | M-571 | 96.8 | 28.4 | 17 | k12-86-2 | 168.1 | 41.9 |
| 6 | DCS-119 | 98.4 | 31.2 | 18 | PVT-12-2 | 114.5 | 37.5 |
| 7 | DCS-84 | 69.8 | 37.9 | 19 | CH-1 | 29.3 | 33 |
| 8 | DCH-177 | 177 | 38.8 | 20 | DCS-97 | 63.4 | 34.5 |
| 9 | DPC-15 | 75.6 | 40.7 | 21 | DCH-1715 | 133.5 | 30.3 |
| 10 | Kh-12-98-3 | 161.4 | 40.0 | 22 | DCS-112 | 100.4 | 33 |
| 11 | DCS-81 | 83.1 | 39.9 | 23 | DPC-21 | 87.4 | 27.1 |
| 12 | DCS-94 | 62 | 37.6 | C 1 | 48-1 | 138.4 | 36.8 |
|  |  |  |  | C 2 | DCH-519 | 119.0 | 28.9 |

\*\*Mean for 2-3 years

Among the selected lines, genotypes with high seed yield (100-177 g/pl) and high HI (35-51.2), include DCS-84, DCS-89, DPC-17, k12-86-2, K12-91-2, k12-98-3 and PVT-12-2.

**7.2.6. Evaluation of advanced lines (C. Lavanya)**: Among 50 promising advanced varieties evaluated, 12 lines were resistant to wilt. Two open pollinated varieties viz., PVT-12-160 (45%) and PVT-12-104 (42%) were high yielding compared to the best check viz., DCS-107 (669 g/plot) and were resistant to wilt (<20%) in sick plot.

**7.2.7. Development of early and medium duration hybrids (C. Lavanya, K.T. Ramya and T. Manjunatha)**: 12 hybrids were generated for confirmation of their yielding ability in replicated trials. 85 crosses were attempted using four pistillate lines M-574, DPC-9, RHC-247, Rb-14 1760 and 30 PMC lines. Twenty pre-bred monoecious lines developed at IIOR were crossed with known pistillate lines in a line x tester mating design. The F*1* seeds obtained from these crosses will be evaluated at IIOR, Yethapur, Hiriyur and Anand. Combining ability of the male lines will be tested and superior hybrid combinations will be identified.

|  |  |
| --- | --- |
| **LINES** | **TESTERS** |
| M-619, SKP-84, JP-77-1, DPC-21, DPC-25 | PMC-4,PMC-7,PMC-9,PMC-11,PMC-13,PMC-18,PMC-19,PMC-27,PMC-31,PMC-32,PMC-35,PMC-39,PMC-55,PMC-57,PMC-58,PMC-60,PMC-61,PMC-66,PMC-67 |

Apart from the hybrids developed in line x tester design, a set of 150 hybrids are developed using 36 pre bred monoecious lines and 11 pistillate lines which will be tested for their yield performance.

**7.2.8. Common Evaluation of hybrids (T. Manjunatha and C. Lavanya)**: 142 hybrids were grown in two rows in an ARBD along with two checks replicated after every 10 entries with a spacing of 90 x 60 cm spacing at IIOR, Hyderabad under rainfed conditios and 120 x 60 spacing at Anand under irrigated conditions.

• At IIOR Hyderabad, trial is sown in late kharif due to delayed monsoon and exposed to prolonged dry spell during the crop growth period. Eleven hybrids were numerically superior to the best check, GCH-7 (82 g/plant) (Table 1).

• At Anand, 24 hybrids out yielded DCH-519 (3274 kg/ha) and 6 hybrids out yielded GCH-7 (3452 kg/ha). Among them, CEH-297 (DPC-23 x GP-537) and CEH-273 (DPC-21 x GP-783) with 35 % and 33 % higher yield to GCH-7 will be further evaluated.

• Five hybrids viz., CEH-346 (DPC-9 x PMC-55), CEH-271 (DPC-21 x GP-640), CEH-352 (SKP-84 x PMC-14), CEH-302 (DPC-23 x GP-699) and CEH-287 (DPC-21 x DCS-89) were high yielding both under rainfed and irrigated conditions.

**Table 4. Promising preliminary hybrids at IIOR, Hyderabad (rainfed conditions)**

|  |  |  |  |
| --- | --- | --- | --- |
| S. No. | Hybrid | Pedigree | Seed yield (g/pl) |
| 1 | CEH-366 | M-574 x AP-37 | 153.5 |
| 2 | CEH-365 | M-574 x AP-20 | 131.6 |
| 3 | CEH-235 | DPC-9 x GP-783 | 129.0 |
| 4 | CEH-231 | DPC-9 x GP-672 | 125.2 |
| 5 | CEH-230 | DPC-9 x GP-538 | 124.4 |
| 6 | CEH-250 | DPC-18 x GP-401 | 123.4 |
| 7 | CEH-263 | DPC-19 x 48-1 | 121.9 |
| 8 | CEH-329 | DPC-25 x JI-384 | 120.3 |
| 9 | CEH-232 | DPC-9 x GP-674 | 120.2 |
| 10 | CEH-346 | DPC-9 x PMC-55 | 111.1 |
| 11 | CEH-234 | DPC-9 x GP-752 | 103.6 |
| 12 | CEH-355 | SKP-84 x PMC-11 | 102.9 |
| 13 | CEH-363 | Rb-1682 x PMC-55 | 100.7 |
|  | DCH-177 |  | 65.7 |
|  | DCH-519 |  | 72.3 |
|  | GCH-7 |  | 82.0 |

**Table 5. Promising preliminary hybrids at Anand (irrigated conditions)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Test hybrid** | **Seed yield (kg/ha)** | **Test hybrid** | **Seed yield (kg/ha)** |
| CEH 297 | 4643 | CEH 307 | 3596 |
| CEH 273 | 4605 | CEH 352 | 3577 |
| CEH 287 | 4432 | CEH 310 | 3538 |
| CEH 268 | 4347 | CEH 284 | 3537 |
| CEH 279 | 4338 | CEH 302 | 3500 |
| CEH 346 | 3969 | CEH 236 | 3473 |
| CEH 288 | 3898 | CEH 258 | 3472 |
| CEH 270 | 3873 | CEH 259 | 3452 |
| CEH 285 | 3854 | CEH 332 | 3408 |
| CEH 290 | 3829 | CEH 324 | 3381 |
| CEH 289 | 3802 | CEH 315 | 3335 |
| CEH 227 | 3705 | CEH 234 | 3335 |
| CEH 337 | 3699 | CEH 281 | 3290 |
| CEH 298 | 3671 | CEH 253 | 3283 |
| CEH 278 | 3671 | DCH 519 © | 3274 |
| CEH 271 | 3628 | GCH 7 © | 3452 |

**Table 6. Top five preliminary hybrids at Anand (irrigated conditions)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Hybrid** | **Pedigree** | **Seed yield (kg/ha)** | **% increase over GCH-7** |
| CEH-297 | DPC-23 x GP-537 | 4643 | 34.5 |
| CEH-273 | DPC-21 x GP-783 | 4605 | 33.4 |
| CEH-287 | DPC-21 x DCS-89 | 4432 | 28.4 |
| CEH-268 | DPC-20 x GP-672 | 4347 | 25.9 |
| CEH-279 | DPC-21 x JI-226 | 4338 | 25.7 |
| GCH-7 © |  | 3452 |  |
| DCH-519 © |  | 3274 |  |

**7.2.9. Preliminary evaluation of hybrids (C. Lavanya):** 24 castor hybrids were evaluated along with parents i.e. 2 female lines (DPC-23 and M-571) and 12 male lines at Bhawanipatna centre along with three check hybrids DCH-177, DCH-519 and PCH-111 under rainfed conditions. Among the 24 hybrids tested, PHT- 14-47 (1181 kg/ha) recorded 27.5% and 18.7% higher yield than the check hybrids DCH-177 (926 kg/ha) and PCH-111(995 kg/ha), respectively.

**7.2.10. Fast track evaluation of hybrids (C. Lavanya and T. Manjunatha)**: Three hybrids were evaluated in large scale (500 plants per entry) in three centres-IIOR, Hyderabad (rainfed) and Anand and SK Nagar (irrigated). PHT-12-3, a short duration hybrid, recorded highest seed yield at IIOR, Hyderabad. It is 39% higher seed yield than another short duration hybrid, DCH-177. At Anand, under irrigated condition, ICH-68 and PHT-12-3 performed better than all three check hybrids. PHT-12-3 (2332 kg/ha) out yielded GCH-7 by 7 %, both under rainfed and irrigated conditions at IIOR, Hyderabad and Anand. Earliest to 50% flowering (47 DAS) and maturity (88 DAS) at IIOR, Hyderabad. This is the only hybrid which recorded 14.6 kg/plot and 75.7 kg/plot at IIOR, Hyderabad (Table 7, Table 8 and Table 9).

**7.2.11. Multi location evaluation of hybrids:** In AHT-I, hybrid DCH-1720 (DPC-21 x DCS-107) recorded 8 %, 12%, 15% yield increase over the checks, GCH-7, DCH-519 and DCH-177 respectively under irrigated conditions. It is resistant to wilt in sick plots at IIOR and SK Nagar, free from root rot in sick plot of Junagadh and resistant to leafhopper with a hopper burn grade (0-1) as compared to 3-4 in susceptible checks at Yethapur and Palem.

**7.2.12. Maintenance breeding:** Nucleus seed of the following released varieties and parental lines are produced by bulking selfed seed of individual plants.

• Varieties: DCS-107 (1 kg), 48-1 (0.5 kg)

• Male lines: DCS-9 (0.5 kg), DCS-78 (0.5 kg)

• Female lines: DPC-9 (0.4 kg), M-574 (0.2)

**Table 7. Fast track evaluation of three hybrids with three checks, IIOR, Hyderabad (2015-16)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Name of Entry** | Plant stand | 1st Picking 90 DAS  (kg/plot) | 2nd Picking 120 DAS  (kg/plot) | 3rd Picking 150 DAS  (kg/plot) | Total  (kg/ plot) | Yield (kg)/Ha | Days to 50% flowering | Days to maturity of primary raceme | Total length of primary spike (cm) | Effective length of primary spike (cm) | Plant height up to primary spike (cm) | Number of effective spikes per plant | No. of capsules per plant | 100 seed weight (g) | Oil content % |
| PHT-12-3 | 510 | 14.6 | 22 | 31.4 | 68 | 2332.0 | 47 | 88 | 38.75 | 38.75 | 98.85 | 14.75 | 62 | 27.95 | 49.4 |
| ICH-66 | 454 | - | 36.1 | 24.1 | 60.2 | 2064.5 | 58 | 127 | 57 | 51.9 | 133.2 | 9 | 136.9 | 32.2 | 50.5 |
| ICH-68 | 457 | - | 31.6 | 28.7 | 60.3 | 2067.9 | 55 | 113 | 48.8 | 46.3 | 153.4 | 10.25 | 113.35 | 31.65 | 48.5 |
| DCH-177 | 506 | - | 22.2 | 26.8 | 49 | 1680.4 | 50 | 97 | 45.3 | 41.75 | 122.5 | 9.25 | 104.1 | 31.78 | 49.6 |
| GCH-7 | 426 | - | 26.7 | 37.1 | 63.8 | 2187.9 | 61 | 134 | 56.3 | 54.4 | 141.7 | 16.55 | 127.85 | 32.05 | 50.5 |
| DCH-519 | 506 | - | 26.4 | 29.7 | 56.1 | 1923.9 | 58 | 125 | 48.05 | 45 | 159.45 | 7.3 | 128.3 | 26.6 | 48.2 |

**Table 8. Fast track evaluation of three hybrids with three checks, Anand (2015-16)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Name of Entry** | 1st Picking 150 DAS (kg/plot) | 2nd Picking 180 DAS (kg/plot) | 3rd Picking 210 DAS (kg/plot) | Total (kg/plot) | Yield (kg)/Ha | Days to 50% flowering | Days to maturity of primary raceme | Number of nodes to primary spikes | Total length of primary spike (cm) | Effective length of primary spike (cm) | Plant height up to primary spike (cm) | Number of effective spikes per plant | No. of capsules per plant | 100 seed weight (g) | Oil content % |
| PHT-12-3 | 25 | 61 | 122 | 208 | 3611.1 | 51 | 116 | 15.6 | 59.4 | 56.4 | 60 | 13.68 | 54.4 | 24.613 | 44.163 |
| ICH-66 | 44 | 67 | 71 | 182 | 3159.7 | 49 | 124 | 18 | 86.2 | 80.6 | 121.8 | 11.52 | 61.8 | 30.643 | 44.866 |
| ICH-68 | 35 | 70 | 108 | 213 | 3697.9 | 49 | 117 | 17.4 | 75 | 71.2 | 115.2 | 13.44 | 56.6 | 28.7 | 43.497 |
| DCH-177 | 24 | 73 | 69 | 166 | 2881.9 | 51 | 115 | 22.4 | 81.2 | 78 | 132.6 | 10.8 | 62.4 | 30.121 | 43.691 |
| GCH-7 | 15 | 56 | 123 | 194 | 3368.1 | 50 | 124 | 17.6 | 79.2 | 75.4 | 111 | 13.08 | 60 | 29.621 | 44.192 |
| DCH-519 | 16 | 15 | 113 | 144 | 2500.0 | 53 | 125 | 19.4 | 73.8 | 69.4 | 121.6 | 12.84 | 55.6 | 27.283 | 44.215 |

**Table 9. Fast track evaluation of three hybrids with three checks, S.K.Nagar (2015-16)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Name of entries** | **Seed yield** | | | | | Final plant stand | Days to 50% flow. of pri.  raceme | Days to  maturity  of pri.  raceme | 100 seed  Wt. (g) | Oil con-tent  (%) | Volume weight (g/100ml) | Length of primary raceme (cm) | Plant height up to pri-mary raceme (cm) | No. of capsules on primary raceme | No of effective spikes/ plant | No of nodes  up to primary raceme |
| **1st pick-ing** | **2 nd pick-ing** | **3 rd pick-ing** | **Total of all pick-ing** | **Yield**  **kg/ ha** |
| PHT-12-3 | 75.7 | 35.5 | 30 | 141.2 | 2842 | 456 | 48 | 126 | 29 | 49.88 | 118.3 | 34.7 | 42.9 | 49.8 | 12.9 | 13. 7 |
| ICH-66 | 58 | 41 | 15 | 114 | 2295 | 545 | 55 | 135 | 32.5 | 46.89 | 118.3 | 54 | 79.9 | 64.7 | 11.5 | 22.1 |
| ICH-68 | 67.7 | 37 | 17 | 121.7 | 2450 | 522 | 56 | 139 | 32.75 | 49.4 | 116.7 | 49.5 | 87. 7 | 53 | 9 | 18.5 |
| DCH-177 | 86 | 20.5 | 12.5 | 119 | 2395 | 576 | 56 | 140 | 30.67 | 49.35 | 116.7 | 53.7 | 74.4 | 54.6 | 12.5 | 17.3 |
| GCH-7 | 67.5 | 65 | 20.5 | 153 | 3080 | 544 | 58 | 142 | 31 | 49.55 | 116.7 | 63.3 | 90.1 | 77.3 | 13.9 | 20.3 |
| DCH-519 | 61.2 | 37.5 | 16 | 114.7 | 2309 | 520 | 52 | 132 | 27.1 | 45.02 | 118.3 | 52.7 | 69.1 | 53.9 | 11.3 | 18.2 |

**7.3. To identify sources of resistance to sucking pests and capsule borer among advanced selections and hybrids (M. Lakshminarayana)**

**7.3.1. Screening of new parental lines against leafhopper :** 3 pistillate lines *viz*., DPC-27, DPC-28, DPC-29 and 3 male lines *viz*., DCS-121, DCS-122, DCS-123 along with 7 checks were evaluated in a RBD of 2 replications.

* DPC-27 and DCS-123 resistant to leafhopper (hopper burn grade 0 to 1)
* DPC-28 and DCS-121 moderately resistant (grade 2)
* DPC-29 and DCS-122 susceptible to leafhopper (grade 3 to 4)
* Resistant checks : (DPC-21, M-571, M-574 and DCH-519): hopper burn grade 0 to 1
* Susceptible checks (DPC-9, DCS-107 and DCH-177): hopper burn grade 3 to 4

**7.3.2.** **Evaluation of selected advanced breeding material against leafhopper :** 30 lines advanced lines were evaluated along with 4 checks in an ARBD.

* 8 advanced breeding materials (PVT-11-5, PVT-11-11; PHT-11-47, 49, 51, 52, 53, 57) found resistant to leafhopper (hopper burn grade 0 to 1)
* 17 lines (PVT-11-2, 3, 17, 18, 19, 21, 26, 34, 59, 61, 70; PHT-11-4, 33, 36, 37, 38, 40) found susceptible to leafhopper (hopper burn grade 3 to 4)

**7.3.3.** **Screening of PHT-11-3-F2 material against leafhopper and semi looper:** Among 240 plants of PHT-11-3-F2 screened against leafhopper, 22 plants were resistant (hopper burn grade 1), 187 plants - moderately Resistant (Grade 2) and 31 plants - susceptible (Grade 3-4) A Free-choice test against semilooper under lab including PHT-11-3 (F1), its parents SKI-291, Ethiopian accession and 2 checks- DCH-519, DCH-177 was done. The results indicated that Ethiopian line less preferred for egg laying by semi looper (27.3 eggs) as compared to PHT-11-3 (62.7 eggs), SKI-291 (51.3), DCH-519 (67.7) and DCH-177 (38.3). Semi looper larvae reared on Ethiopian line showed longer larval period (21-23days) as compared to 15-17 days in PHT-11-13 , SKI-291 and checks.

# 7.4. To identify sources of wilt resistance among elite parental lines and hybrids (M. Santha Lakshmi Prasad)

* Among 76 parental lines, 6 entries viz., PVT-11-3, PVT-11-19, DPC-21, DPC-29, PMC-65, PMC -77 recorded highly resistant reaction (0 % wilt incidence) in the wilt sick plot.
* 43 lines recorded low wilt incidence (<20% ) viz., PVT-1-14-189, PVT-1-12-2, PVT-1-12-3, PVT-1-12-4, PVT-1-12-6, PVT-1-12-7, PVT-1-12-8, PVT-1-12-9, PVT-1-12-72, PVT-1-12-88, PVT-1-12-90, PVT-1-12-98, PVT-1-12-103, PVT-1-12-104, PVT-1-12-160, PVT-1-12-161, PVT-1-12-167, PVT-11-2, PVT-11-11, PVT-11-17, PVT-11-18, PVT-11-21, PVT-11-26, PVT-11-59, PVT-11-61, DPC-17, DPC-18, DPC-19, DPC-20, DPC-23, DPC-24, DPC-25, DPC-28, PMC-67, PMC-78, PMC-10, PMC-13, PMC-22, PMC-32, PMC-43, PMC-47, PMC-66, PMC-74.
* In the National screening nursery for wilt (NSNW), 2 hybrids, 5 male lines and 3 pistillate lines were screened both at IIOR and SK Nagar (Table 10).

**Table 10. Screening of entries in National Screening Nursery Wilt (IIOR, Hyderabad,**

**S.K. Nagar, 2015-16)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Entries** | **IIOR, Hyderabad** | | **S.K. Nagar** | |
| **Plant Stand** | **Wilt incidence at**  **150 DAS ( % )** | **Plant Stand** | **Wilt incidence at**  **180 DAS ( % )** |
| PHT-1-15-122  (DPC-21 x GP-783) | 39 | 10.7 | 56 | 0.0 |
| PHT-1-15-251  (DPC-25 x DCS-123) | 34 | 17.4 | 41 | 2.4 |
| DCS-121 | 34 | 39.4 | 45 | 4.4 |
| PVT-12-160 | 36 | 24.8 | 53 | 15.1 |
| PVT-12-103 | 34 | 11.9 | 48 | 14.6 |
| DPC-21 | 34 | 6.2 | 53 | 5.7 |
| DPC-23 | 27 | 30.8 | 34 | 5.9 |
| DCS-118 | 30 | 4.2 | 35 | 2.9 |
| DCS- 123 | 21 | 5.6 | 12 | 0.0 |
| M-571 | 27 | 8.1 | 33 | 9.1 |
| JI-35 (S) | 32 | 98.8 | 57 | 98.2 |
| 48-1 (R) | 35 | 6.4 | 59 | 0.0 |

**Significant achievements**

* Among the three pistillate lines viz., DPC-21, DPC-25 and M-571 confirmed for wilt and leafhopper resistance for two years, DPC-21 and M-571, were good combiners for seed yield, primary spike length and duration and will be further proposed for registration by PGRC, ICAR as wilt and leafhopper resistant pistillate lines with distinct morphological characters.
* Two high yielding open pollinated varieties viz., PVT-12-160 (45%) and PVT-12-104 (42%) compared to the best check viz., DCS-107 (669 g/plot) and were also resistant to wilt (<20%) in sick plot.
* Studies on physiological parameters identified that pistillate lines like DPC-21, M-571 and male lines like DCS-107, DCS-9, and 48-1, DCS-78, DCS-119 with high seed yield (100-153 g /plant) and high HI (30-39.6%) are promising for generation of hybrids.
* Based on the last 3-4 years data, 66 genotypes were statistically analyzed and ranked for 6 characters every year viz., seed size, early vigor, TDM at 35 DAS, TDM at harvest, seed yield/plant and HI. Nine genotypes including male lines like DCS-78, DCS-105, DCS-107, DCS-108, DCS-119, female lines like DPC-21, M-574, M-571 and hybrid DCH-1715 were identified as best genotypes for early vigour, TDM and HI.
* **Selection of castor parents with high HI**: Among 20 breeding lines evaluated to select lines with high HI during rabi 2015, genotypes with 42-46.7% HI include DCS-9, DCS-78, DCS-84, DCS-97, DCS-112, DCS-119, DPC-9, PVT 12-2, K12-98-3. The breeding line Kh-12-98-3 recorded highest HI of 46.7%. It has early vigor (0.81g/pl.), high TDM (230g/pl.) and good seed yield (98.4g/pl.) also.
* Among 66 genotypes evaluated for three years, 23 genotypes were identified for early vigor and high HI for two years. Among the selected lines, genotypes with high seed yield (100-177 g/pl) and high HI (35-51.2), include DCS-84, DCS-89, DPC-17, k12-86-2, K12-91-2, k12-98-3 and PVT-12-2.
* **Common evaluation of hybrids:** At Anand, 6 hybrids out yielded the best check, GCH-7 (3452 kg/ha). Among them, CEH-297 (DPC-23 x GP-537) and CEH-273 (DPC-21 x GP-783) with 35 % and 33 % higher yield to GCH-7 will be further evaluated. Five hybrids viz., CEH-346 (DPC-9 x PMC-55), CEH-271 (DPC-21 x GP-640), CEH-352 (SKP-84 x PMC-14), CEH-302 (DPC-23 x GP-699) and CEH-287 (DPC-21 x DCS-89) were high yielding both under rainfed and irrigated conditions.
* **Fast track evaluation of hybrids**: Three hybrids were evaluated in large scale (500 plants per entry) in three centres-IIOR, Hyderabad (rainfed) and Anand and SK Nagar (irrigated). PHT-12-3, a short duration (88 DAS) hybrid, recorded 39% higher seed yield than another short duration (97 DAS) hybrid, DCH-177 (1680 kg/ha). At Anand, under irrigated condition, ICH-68 (3698 kg/ha) is 10% higher than the best check, GCH-7 (3368 kg/ha) while PHT-12-3 (3611 kg/ha) is 25% higher than DCH-177 (2882 kg/ha).
* **Hybrid in pipeline:** In AHT-I, hybrid DCH-1720 (DPC-21 x DCS-107) recorded 8 %, 12%, 15% yield increase over the checks, GCH-7, DCH-519 and DCH-177 respectively under irrigated conditions. It is resistant to wilt in sick plots at IIOR and SK Nagar, free from root rot in sick plot of Junagadh and resistant to leafhopper with a hopper burn grade (0-1) as compared to 3-4 in susceptible checks at Yethapur and Palem.

1. **Output During Period Under Report**
   * Three hybrids in pipeline: DCH-1720 in AHT-II, ICH-66, ICH-68 in AHT-I
   * Three pistillate lines –DPC-21, DPC-25, M-571, confirmed for wilt resistance and combining ability ready for registration.

* **List of Publications (one copy each to be submitted with RPP-II)**
  + 1. Research papers :
* P.Lakshmamma, Lakshmi Prayaga, **C. Lavanya** and C. Sarada (2014): Genetic diversity, variability and heritability for root, shoot and water use efficiency traits in castor (Ricinus communis L.) genotypes. Indian Journal of Plant genetic Resources, 27 (3): 230-237 (DOR/NRM-65/13)
* **C. Lavanya**, P. Duraimurugan and M. Santhalakshmi Prasad, 2016. Development of leafhopper and wilt resistant parental lines in castor through conventional breeding approaches. In Souvenir and Book of Abstracts. National Seminar on Breeding of field crops for biotic and abiotic stresses in relation to climate change, 28-29th March, 2016. ISBN No. :978-93-85162-80-0. 13p.
* P. Duraimurugan, M. Lakshminarayana and **C. Lavanya**, 2016. Evaluation of parental lines of castor hybrids for resistance to leafhopper, Empoasca flavescens. In: Souvenir and Book of Abstracts. National Seminar on “Breeding of field crops for biotic and abiotic stresses in relation to climate change, 28-29th March, 2016. ISBN No.:978-93-85162-80-0. 235 pp.
* Praduman Yadav and **Lavanya, C**. 2015. Oxidative stress and antioxidative defence system in Ricinus communis (L.) under high temperature stress. 3rd International Plant Physiology Congress, 11-14th December, 2015.

**Scientific / teaching reviews:**

* Varaprasad, K.S. and **Lavanya,C**. 2015. Innovative approaches to break yield barrier in oilseeds and improved strategies in quality seed supply. In Proceedings of 8th National Seed Congress, 27-29th October, 2015.
* Intellectual Property Generation

(Patents - filed/obtained; Copyrights- filed/obtained; Designs- filed/obtained; Registration details of variety/germplasm/accession if any)

* **DCS-107, a CVRC released castor variety in 2011 is registered as a new plant variety by PPV & FRA with an exclusive right to produce, sell, market, distribute, import or export the variety for initial term of 6 years and renewable for the remaining years from the 27th day of April, 2015. Registration No.123 of 2015, Date of Grant: 27th April, 2015.**
* **Presentation in Workshop/Seminars/Symposia/Conferences (relevant to the project in which scientists have participated)**
* Varaprasad, K.S. and **Lavanya,C**. 2015. Innovative approaches to break yield barrier in oilseeds and improved strategies in quality seed supply. In Proceedings of 8th National Seed Congress, 27-29th October, 2015.
* **C. Lavanya,** P. Duraimurugan and M. Santhalakshmi Prasad, 2016. Development of leafhopper and wilt resistant parental lines in castor through conventional breeding approaches. In Souvenir and Book of Abstracts. National Seminar on Breeding of field crops for biotic and abiotic stresses in relation to climate change, 28-29th March, 2016. ISBN No.:978-93-85162-80-0. 13 pp.
* P. Duraimurugan, M. Lakshminarayana and **C. Lavanya**, 2016. Evaluation of parental lines of castor hybrids for resistance to leafhopper, Empoasca flavescens. In: Souvenir and Book of Abstracts. National Seminar on Breeding of field crops for biotic and abiotic stresses in relation to climate change, 28-29th March, 2016. ISBN No.:978-93-85162-80-0. 235 pp.
* T. Manjunatha, K.T. Ramya and **C. Lavanya,** 2016. Effect of increased seasonal temperature on hybrid seed production in castor. In Souvenir and Book of Abstracts. National Seminar on Breeding of field crops for biotic and abiotic stresses in relation to climate change, 28-29th March, 2016. ISBN No.:978-93-85162-80-0. 141 pp.
* Details of technology developed: (Crop-based; Animal-based, including vaccines; Biological – biofertilizer, biopesticide, etc; IT based – database, software; Any other – please specify)
* **Trainings/demonstrations organized :** As PI, AICRP (Castor), organized a Germplasm cum Breeder’s day from 15-16th December, 2015 at Narkhoda farm, IIOR, Hyderabad. 31 castor researchers participated in the event. Indents were received from breeders mainly for pistillate lines and male lines. Parental lines seed is under multiplication for seed supply.
* **Training received**: MDP on Leadership Development (a Pre-RMP programme) from November 30-December 11, 2015 at NAARM, Hyderabad
* **Any other relevant information** : Co-Authored the paper “Evaluation of parental lines of castor hybrids for resistance to leafhopper, *Empoasca flavescens*, got the best oral presentation in the National Seminar on “Breeding of field crops for biotic and abiotic stresses in relation to climate change” during 28-29th March, 2016 held at College of Agriculture, VNMKV, Parbhani (M.S.), India.

1. Constraints experienced, if any : Nil
2. Lessons Learnt: -
3. Evaluation
   * + 1. Self-evaluation of the project for the period under report by the PI with rating

10

in the scale of 1 to 10

* + - 1. Evaluation by PI on the contribution of the team in the project including self

|  |  |  |  |
| --- | --- | --- | --- |
| S. No. | Name | Status in the project  (PI/CC-PI/Co-PI) | Rating in the scale of  1 to 10 |
| 1 | C. Lavanya, Principal Scientist (Plant Breeding) | PI | 10 |
| 2 | S. Senthilvel, Senior Scientist (Plant Breeding) | Co-PI | 10 |
| 3 | T. Manjunath, Scientist (Plant Breeding) | Co-PI | 10 |
| 4 | K. T. Ramya, Scientist (Plant Breeding) | Co-PI | 10 |
| 5 | P. Lakshmamma, Principal Scientist (Plant Physiology) | Co-PI | 10 |
| 6 | M. Lakshmi Narayana, Principal Scientist (Entomology) | Co-PI | 10 |
| 7 | M. Santha Lakshmi Prasad (Plant Pathology) | Co-PI | 10 |

1. Signature of PI, CC-PI(s), all Co-PIs

Dr. C. Lavanya, Principal Scientist (Plant Breeding)- PI

Dr. S. Senthilvel, Senior Scientist (Plant Breeding)-Co-PI

Dr. T. Manjunath, Scientist (Plant Breeding) Co-PI

Dr. K. T. Ramya, Scientist (Plant Breeding) Co-PI

Dr. P. Lakshmamma, Principal Scientist (Plant Physiology) Co-PI

Dr. M. Lakshmi Narayana, Principal Scientist (Entomology) Co-PI

Dr. M. Santha Lakshmi Prasad (Plant Pathology) -Co-PI

1. Signature (with specific comments on progress/achievements, shortfall and

constraints along with rating of the project in the scale of 1 to 10) of

Head of Division/Regional Center / Section

Dr. M. Sujatha

Principal Scientist & Head, Crop Improvement

ICAR-IIOR, Rajendranagar, Hyderabad-30

1. Comments of IRC : Enclosed
2. Signature (with specific comments on progress/achievements, shortfall

and constraints along with rating of the project in the scale of 1 to 10)

of JD (R)/ Director

**ICAR- INDIAN INSTITUTE OF OILSEEDS RESEARCH**

**Proceedings of IRC (2016)**

IRC meeting of this Institute was held during 25-27, June, 2016 under the Chairmanship of Dr. K. S. Varaprasad, Director, IIOR. In this IRC, the research results of the projects conducted during Kharif 2015 were presented by the Principal Investigator of the respective projects which were reviewed. During the deliberations, the following recommendations are made.

**PROJECT 103-13: DEVELOPMENT OF HIGH OIL YIELDING CASTOR HYBRIDS RESISTANT TO FUSARIUM WILT, LEAF HOPPER AND DROUGHT**

PI: Dr. C. Lavanya

* Three to four activities based on the priority should be taken up to achieve the target envisaged under this project.
* *Spodoptera* resistant material may be checked by Entomologist.
* Specific and separate activities should be assigned to each of the Co- PIs
* DCH-177 may be improved by addressing the weakness of the hybrid like low seed weight, etc