**2.6. Development of male lines**: It is simultaneous to the development of varieties in castor. The main objectives were to develop early or medium duration (150 days), short to medium tall, high oil, high seed yield and diverse inbreds with resistance to wilt complex and insect pests. Crossing programme between pistillate x male, male x male, pistillate x germplasm and male x germplasm accessions was done either in single, double, triple or back cross followed by pedigree method of selection. Two major gaps were identified during the course of the research work and rectified by taking suitable corrective measures.

* **Introduced a systematic planning for male line development:** A common set of crosses were used to develop both female and male lines leading to the lack of genetic diversity between parental lines. Special emphasis is now laid in selection of parents for crossing programme, pedigree of the parents and enhancing diversity through diallel and multiple crossing programme.
* **Developed selection criteria for male lines:** Emphasis on wilt resistance alone led to the gradual loss of yield contributing genes. Simultaneous selection for high seed yield, yield components and wilt resistance is practiced now.
* Selection for male lines was done as a part of varietal breeding programme leading to the development of male lines with high pistillate expression. Seed setting in seed production plots was low either due to the insufficient pollen or poor pollen shedding as observed in DCS-9, male line of DCH-177. Introduced the selection criteria for selection of male lines like the number of whorls of male flowers on the spike, pollen shedding, viability etc.

**Promising male lines for seed yield and other traits**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Entry | Seed yield (kg/ha) | Morphologicalcharacters | Node number to primary | Special traits |
| DCS-105 | 1725 | R2Sp | 12-15 | Good branching, early duration |
| DCS-106 | 1595 | G3NSp | 12-16 | Resistant to wilt and leaf hopper |
| DCS-107 | 1760 | G2Sp | 16-18 | Resistant to wilt, high 100-seed weight (30g) |
| DCS-108 | 1369 | R2Sp | 9-13 | Resistant to wilt |

*R/G- Stem colour, 1-3 distribution of bloom, Sp-Spiny, NSp-non spiny*

**2.7. Identification of new male lines**: Twelve promising new male lines *viz*., DCS-109 to DCS-120 were multiplied by bulking single plant selfed seed, maintained and used in the development of hybrids (Table 24).

**Table 24. New male lines identified from breeding material (*kharif*, 2009-10)**

|  |  |  |  |
| --- | --- | --- | --- |
| **S. No.** | **Selection No.** | **Pedigree** | **Morphological characters** |
| 1 | DCS-109 | M-584 /DCS 78 | 14N, G3Sp, LS, loose |
| 2 | DCS-110 | M-584 /DCS 78 | 13N, G3Sp, VSS, VGBr, LS, loose |
| 3 | DCS-111 | DCH-177/DCS 71 | 12-14 N, R2Sp, SS, GBr, ML, SC |
| 4 | DCS-112 | DCH-177/JI 133 | 14 N, G2Sp, VSS, HBr, ML, SC |
| 5 | DCS-113 | DPC-9/DCS-59 | 14 N, G2Sp, VSS, HBr, ML, SC |
| 6 | DCS-114 | DPC-9/DCS-59 | 13 N, G2Sp, ML, SC |
| **7** | DCS-115 | DPC-9/SKI-180 | G3Sp |
| 8 | DCS-116 | M 619/ DCS 94 | 13NR3Sp, GBr, ML, Loose |
| 9 | DCS-117 | Kranthi/REC-116 | 20N, R2Sp, L, T, HBr, ML, SC |
| 10 | DCS-118 | Kranthi/REC-116 | 18NG3Sp, VSS, T, HBr, ML, CS |
| 11 | DCS-119 | RG-1582 /DCS-94 | G3Sp, GBr, VSS, ML, SC |
| 12 | DCS-120 | RG-1582/DCS-5 | R3Sp, VSS, VGBr, ML, SC |

*R/G- Stem colour , N-Number of nodes to primary, 1-3 distribution of bloom, VGBr- very good branching, HBr-high branching, Sp-Spiny, VLS-Very long spike*

**2.8. Characterization of new male lines for specific traits**: Seven male lines developed during 2011-12 were evaluated for resistance to major pests and diseases and fatty acid profile. Screening for resistance to *Fusarium* wilt in wilt sick plot indicated four male lines *viz*., DCS-109, DCS-112, DCS-117,DCS-118 as resistant to wilt with <20% wilt incidence compared to the susceptible check JI-35 (Table 25). Screening for major insect pests indicated that DCS-109, DCS-110, DCS-118, DCS-119 as resistant to leaf hopper.

Thirty five parental lines including 12 pistillate lines and 23 male lines were evaluated for the fatty acid profile at DOR, Hyderabad. The line DCS-119 recorded highest ricinoleic acid (92.77%) followed by DCS-106 (90.32 %) and DCS-97 (90.17 %) (Table 26).

**Table 25. Wilt incidence in new male lines in wilt sick plot (2012-13)**

|  |  |  |
| --- | --- | --- |
| Entry | Plant stand | Wilt incidence (%) at days after sowing (DAS) |
| 30 DAS | 60 DAS | 90 DAS | 120 DAS | 150 DAS | 180 DAS |
| DCS-109 | 28 | 3.6 | 7.1 | 7.1 | 7.1 | 7.1 | 14.3 |
| DCS-110 | 27 | 7.7 | 11.2 | 18.4 | 18.4 | 25.8 | 29.4 |
| DCS-112 | 27 | 3.6 | 7.4 | 7.4 | 7.4 | 7.4 | 14.6 |
| DCS-113 | 29 | 6.7 | 13.6 | 17.2 | 20.5 | 34.8 | 41.5 |
| DCS-117 | 29 | 0 | 10.2 | 10.2 | 10.2 | 20.9 | 20.9 |
| DCS-118 | 28 | 3.6 | 7.1 | 7.1 | 10.7 | 10.7 | 10.7 |
| DCS-119 | 25 | 4.2 | 37.2 | 37.2 | 37.2 | 37.2 | 37.2 |
| JI-35 © | 26 | 11.5 | 34.6 | 76.9 | 84.6 | 88.5 | 100 |
| 48-1 © | 26 | 0 | 0 | 0 | 3.3 | 3.3 | 3.3 |

**Table 26. Fatty acid profile of male lines (2012-13)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Entry** | **Stearic acid** | **Oleic acid** | **Linoleic acid** | **Linolenic acid** | **Ricinoleic acid** | **DHSA** |
| DCS-109 | 1.35 | 5.6 | 3.91 | 1.19 | 87.36 | 0.58 |
| DCS-110 | 1.25 | 5.18 | 4.26 | 0.95 | 87.81 | 0.54 |
| DCS-112 | 1.23 | 5.23 | 3.92 | 1.21 | 87.61 | 0.79 |
| DCS-113 | 1.29 | 5.58 | 3.66 | 1.39 | 87.37 | 0.71 |
| DCS-117 | 1.27 | 5.0 | 3.74 | 1.17 | 88.3 | 0.53 |
| DCS-118 | 1.29 | 5.14 | 5.15 | 1.34 | 86.46 | 0.62 |
| DCS-119 | 0.59 | 2.86 | 2.85 | 0.44 | **92.77** | 0.49 |
| DCS-97 | 1.08 | 4.43 | 2.9 | 0.85 | **90.17** | 0.57 |
| DCS-106 | 1.05 | 4.2 | 3.01 | 0.73 | **90.32** | 0.69 |
| Gudur local | 1.62 | 6.13 | 6.2 | 1.33 | 83.99 | 0.73 |
| DCS-9 © | 1.22 | 5.36 | 3.43 | 1.46 | 87.78 | 0.74 |
| DCS-107 © | 1.06 | 4.59 | 3.41 | 1.15 | 89.03 | 0.75 |

**2.9. Screening for *Botrytis* under field and artificial inoculation conditions:** Among 16 advanced male lines in Set I, 22 lines in Set II screened under artificial inoculation conditions for *Botrytis* resistance,10 lines were resistant to *Botrytis* (<20% incidence). Bases on the three years data, PVT-IV-2 and PVT-IV-3 are resistant to both wilt and *Botrytis* while PVT-IV-17, 21, 22, PVT-II-39, 40, 43, 71 and DCS-107 to *Botrytis* alone.

**Promising wilt and *Botrytis* resistant advanced lines**

|  |  |  |  |
| --- | --- | --- | --- |
| **Entry** | **Pedigree** | **Wilt (%)** | ***Botrytis* incidence (%)** |
| **2008** | **2009** | **2010** |
| PVT-IV-1 | DPC-9/DCS-75 | 0 | 40 | 50 |
| PVT-IV-2 | DPC-13/DCS-9 | 0 | 21.1 | 15.1 |
| PVT-IV-3 | DPC-9/DCS-75 | <20% | 7.6 | 11.1 |
| PVT-IV-4 | DPC-9/GCH-6 | <20% | 44.2 | 66.8 |
| PVT-IV-5 | DPC-9/RG-297 | <20% | 44.3 | 35.4 |
| PVT-IV-6 | DPC-9/RG-297 | <20% | Ns | 28.5 |
| PVT-IV-7 | DPC-9/RG-1647 | <20% | 71.4 | 52.2 |
| PVT-IV-10 | DPC-9/RG-1713 | <20% | 60.7 | 44.4 |
| PVT-IV-17 |  - |  | 15.5 | 11.8 |
| PVT-IV-21 | M-584 / DCS 78 |  | 20.9 | 12.5 |
| PVT-IV-22 | DCH-177/ DCS 71 |  | 7.4 | 5.3 |
| PVT-IV-23 | DCH-177 / JI 133 |  | 28.5 | 25 |
| PVT-IV-25 | DPC-9 / DCS-59 |  | 22.2 | 37.5 |
| PVT-II-39 | M-619/DCS-94 |  | 15.2 | 13.8 |
| PVT-II-40 | M-619/DCS-94 |  | 15.1 | 18 |
| PVT-II-43 | M-619/DCS-94 |  | 11.8 | 17.6 |
| PVT-II-71 | DPC 9 / DCS 59 | 5.5 |  | 23.1 |
| PVT-II-80 | DCS-107 | 0 |  | 18.6 |
| DCS-9 © |  | 19 | 89.6 | 86.7 |

**2.10. Evaluation of promising advanced lines for defoliators and leaf hoppers:** Among 20 promising wilt resistant advanced lines, PVT-I-10-10 is moderately resistant to leaf hopper. Among the mutant DPC-9 selections, 55 double bloom and triple mutant selections were resistant to leaf hopper even under heavy natural incidence of leaf hoppers for the last two years.

**Promising male combiners for seed yield identified in the project**

| Entry | GCA effects for seed yield in different pickings |
| --- | --- |
| First | Second | Final |
| Lines |  |  |  |
| DPC-9 | -20.07 | -13.98 | 71.94\*\* |
| Testers |  |  |  |
| DCS 91 | 108.02\*\* | 153.22\*\* | 197.17\*\* |
| DCS 94 | 55.44\* | 44.87 | 210.16\*\* |
| DCS 96 | 120.97\*\* | 132.36\*\* | 259.61\*\* |
| DCS 97 | -13.94 | -30.88 | 117.83\*\* |
| DCS 104 | 53.45\* | -20.63 | 239.03\*\* |
| DCS 106 | 62.96\* | 46.07 | -108.77 |
| DCS-119 | 51.49\* | -44.50 | 18.08 |