Plant Germplasm Registration Notice*

The Plant Germplasm Registration Committee of ICAR in its XXVIth meeting held on January 31, 2013 at the National Bureau of Plant Genetic Resources, New Delhi approved the registration of 50 germplasm lines out of which information on 19 lines is presented in this issue. The information on registered germplasm is published with the purpose to disseminate the information to respective breeders for utilization of these genetic stocks in their crop improvement programmes. Upon request, the developer(s)/author(s) is/are obliged to distribute the material for crop improvement programme of National Agricultural Research System.

1. Vaidehi 95 (MSH- 53) (IC0584260; INGR13032) Dark Brown Linted Introgressed Derivative of Cotton

V Gotmare, P Mohan, G Balasubramani, VN Waghmare, C Rodge, M Katre, BN Tule, PK Chakrabarty and KR Kranthi

Central Institute for Cotton Research, Post Bag No 2, Shankarnagar PO, Nagpur-440010, Maharashtra (E-mail: gotvp2001@yahoo.co.in)

Vaidehi-95 (MSH-53) is a multispecies introgressed reverted tetraploid genotype derived from hexaploid progenies of the cross between *Gossypium hirsutum, G. raimondii, G. barbadense* and *G. thurberi* developed at the Central Institute for Cotton Research (CICR), Nagpur It uniquely possesses dark brown naturally coloured lint. The plant has open canopy and possesses leaves with long pedicel that allow direct penetration of sunlight minimizing bollworm attack. The genotype is also highly tolerant to Jassids by virtue of being a derivative of wild species namely *G. raimondii* and *G. thurberi.* The genotype is homozygous and stable.

The National Gene Bank at CICR possesses colour *G. hirsutum* accessions of various shades like light brown, dark brown and light green. The above colour linted accessions could not be used in breeding programme due to poor fibre quality, colour instability and extremely low yield potential. However, they were preserved as novelty mutant genetic stocks by the breeders in Cotton Gene Bank. The introgressed genotype Vaidehi-95 (MSH-53) overcomes many such limitations and possess durable colour with comparatively better fibre quality traits.

Morpho-agronomic Characteristics

The plant grows to an average height of 113 cm, leaves with admeasuring 5.5- 6.5 x 4 cm, palmate, central lobe much longer, veins covered by trichomes, petiole 3.3-3.9 cm long. Inflorescences axillary, flower solitary, short pedicels, free bracteoles, covering one third of the capsule. Flowers perfect, wide spreading cream coloured petals, calyx undulated, light yellow pollen grains, oblong green bolls, four loculed when open with 9 -11 seeds per capsule and dark brown colour lint and fuzz.

Associated Characters and Cultivated Practices

1.	Yield/plant	113 (g/pl)
2.	Fibre length (2.5% span length)	20.8 mm
3.	Fibre strength (g/tex)	17.2
4.	Uniformity ratio (%)	44
5.	Micronaire value	4.1
6.	GOT	38
7.	Boll numbers per plant	50
8.	Boll weight (gm)	3.42
9.	Highly tolerant to Jassids, Bollworm and Cotton Leaf Curl Virus	

Vaidehi-95 (MSH-53) being a multispecies introgressed derivative can be used in breeding programme for development of dark brown linted promising varieties of *G. hirsutum* and intra- hirsutum colour hybrids. It could be used as a marker trait and has scope for its utility for manufacturing naturally coloured fabrics and would be economically suitable for market/ consumers. Characteristic aesthetic feature of the genotype is that initial light colour of the lint becomes darker with continued exposure to sunlight in the field. Vaidehi – 95 (MSH- 53) was tested for fastness for three years (2008, 2009 and 2010) and that resisted fading of colour during storage.

*Compiled and edited by: Anjali Kak and RK Tyagi, Division of Germplasm Conservation, National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi-110 012

Package of Practices

Deep ploughing of the land once in 2-3 years followed by shallow cultivations every year is recommended. Use of Pre Plant Incorporation of Di-Nitro-Aniline herbicide @ 1 kg Active Ingredient (AI) ha^{-1} can control weeds efficiently. Apply farmyard manure about 5 tonnes ha^{-1}. A basal dose of NPK 30:30:30 and top dressing with 30 kg nitrogen ha^{-1} may be given depending upon the soil fertility. The genotype responds well to higher fertilizer dose. One or two sprays with 2% DAP after flowering will boost the yield.

The seed rate of 16 -20 kg ha^{-1} is sufficient for High Density Planting System in 30 x 15 cm and will vary depending upon spacing. Under irrigated conditions narrow spacing of 90 x 20 cm keeping one plant $hill^{-1}$ may be practiced. In marginal soils, under rainfed conditions, a spacing of 60 x 30 cm will be sufficient. Early sowing is advocated for rainfed crop. Isolation of areas growing colour cotton is advocated to avoid contamination of white linted varieties. The crop matures in 145-150 days.

Vaidehi-95 (MSH-53) is tolerant to sucking pest, the insecticide spray may be given only as and when the pest population exceeds the threshold level. For control of bollworm, need based insecticide sprays may be administered.

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Vaidehi-95 (MSH-53) is tolerant to sucking pest, the insecticide spray may be given only as and when the pest population exceeds the threshold level. For control of bollworm, need based insecticide sprays may be administered.

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Table 1: Characteristic Features of NISC- 40, NISC- 43 and NISC 44:

Trait	Genotype		
	NISC- 40	NISC- 43	NISC-44
Yield/plant (g)	63.0	52.0	88.0
Fibre length (2.5% span length)	22.3	23.3	21.7
Fibre strength	17.5	19.3	18.2
Uniformity ratio	49.7	51	50.7
Micronaire value	3.6	3.8	3.2
GOT	40.1	37.5	34.9
Boll numbers per plant	18	20	37
Boll weight (g)	3.1	2.9	3.42
Plant height (cm)	69.9	72.1	84
Highly tolerant to jassids and bollworm			

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AK Roy, P Kaushal and DR Malaviya
Indian Grassland and Fodder Research Institute, Jhansi- 284 003, Uttar Pradesh
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Pearl millet (*Pennisetum glaucum* L., Poaceae) is an important crop utilized both for feed and fodder purposes in semi arid tropics. Exotic germplasm in the genus *Pennisetum* comprises of primary, secondary and tertiary gene pools with many species possessing desirable genes for pearl millet improvement such as resistance to diseases, male sterility, improved fodder characteristics and apomixis into pearl millet (Jauhar and Hanna, 1998). *P. squamulatum*, a wild relative of pearl millet, harbours many desirable traits for pearl millet improvement (Hanna

et al. 1989). We've previously reported a novel cytotype of *Pennisetum squamulatum* (accession IG 98-36, 2n=56) (Roy *et al.* 2003) and subsequently got it registered with NBPGR (INGR 06017). Since, *P. squamulatum* is obligate apomictic as well as highly tolerant to many biotic and abiotic stresses, its hybrids with cultivated pearl millet may provide useful material for gene introgression and apomictic studies. Successful interspecific hybrids were obtained between an induced tetraploid line of pearl millet (2n=4x=28, genome status *GGGG*) (IG 99-748, registered INGR 09047) and the new cytotype of *P. squamulatum* (2n=8x=56, *SSSSSSSS*) for the first time. Out of a total of 233 F1 hybrids analyzed, majority of the hybrids were facultative apomictic in reproduction, owing to multigene control, genetic segregation and modifying effects, and plants with obligate mode of reproduction were rare. However, two of these hybrids viz. H1 (=P. sq H1; GSH1; IG 08-37) and H2 (=P. sq H2; GSH2; IG 08-38) were identified to be obligate sexual and obligate apomictic, respectively (Kaushal *et al.,* 2007). These hybrids have been characterized for their morphology, cytology, flow cytometry and reproductive characters.

The hybrids were intermediate to the parents, with preponderance of male-parent characters. Hybrids resembled *P. squamulatum* in tillering ability, perenniality, inflorescence characters, shedding spiklets and short involucral pedicles, while resembled female parent in leafiness and penicillate anther tips (more dense in H1 than H2). Hybrid H2 was more vigourous than H1. Segregation for certain characters, such as node colour and hairiness, violet stigma colour, tillering behaviour, and other traits observed in the hybrids suggests heterozygous nature of *P. squamulatum*. Cytologically, the hybrids had intermediate DNA content as compared to parents, estimated using flow cytometric analysis. Both the hybrids exhibited 2n=42 chromosomes, 14 derived from tetraploid pearl millet and 28 from *P. squamulatum*. Average chromosome configurations were (0.44_{IV}+0.8_{III}+17.36_{II}+3.12_{I}) for H1 and (0.009_{V}+0.44_{IV}+0.34_{III}+19.4_{II}+0.37_{I}) for H2. Hybrid H1 was highly male fertile (84% pollen stainability) and set fertile seeds (37%). Embryo-sac (ES) analysis using Differential Interference Contrast microscopy exhibited this plant to be obligate sexual, characterized by all eight-nucleated polygonum type sexual ES. Owing to highly heterozygous nature of *P. squamulatum*, this hybrid would produce segregating progeny upon self-pollination and may not produce true-to-type plants. However, they have high perenniality vigour and are easily maintained by rooted slips. Hybrid H2 was identified as obligate apomictic on the basis of ES studies as it exhibited all four-nucleated *Panicum* type ES. It was 65% male fertile, however was a shy seed setter (13%). This plant has a very high vigour and perenniality, and can well be propagated through rooted slips.

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Table 1: Characteristic Features of NISC- 40, NISC- 43 and NISC 44:

Trait	Genotype		
	NISC- 40	NISC- 43	NISC-44
Yield/plant (g)	63.0	52.0	88.0
Fibre length (2.5% span length)	22.3	23.3	21.7
Fibre strength	17.5	19.3	18.2
Uniformity ratio	49.7	51	50.7
Micronaire value	3.6	3.8	3.2
GOT	40.1	37.5	34.9
Boll numbers per plant	18	20	37
Boll weight (g)	3.1	2.9	3.42
Plant height (cm)	69.9	72.1	84
Highly tolerant to jassids and bollworm			

conditions, a spacing of 60 x 30 cm is sufficient. The plant type being compact in nature; these genotypes are also suitable for High Density Planting System (HDPS) and also for Organic cultivation. Early sowing is advocated for rainfed crop. Isolation distance is advocated to avoid contamination of white linted varieties. The crop matures in 145-150 days.

All the three genotypes namely NISC-40, NISC-43 and NISC-44 are highly tolerant to Jassids and Bollworm. Insecticide spray may be given only as and when the pest population exceeds the threshold level. Need based insecticide sprays may be taken up to control Bollworm attack. Additionally NISC-44 also shows tolerance to drought.

3. P. sq H1; IG08-37 (IC0593641; INGR13036) Interspecific Hybrid between Pearl millet (*Pennisetum glaucum*) and *P. squamulatum* (novel cytotype, 2*n*=56). Obligate Sexual in Reproduction. Chromosome Number, 2*n*=42 (14G+28S), (genomic status *GGSSSS*)

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P. sq H2; IG-08-38 (IC0593642; INGR13037) Interspecific Hybrid between Pearl millet (*Pennisetum glaucum*) and *P. squamulatum* (novel cytotype, 2*n*=56). Obligate Apomictic in Reproduction, Chromosome Number, 2*n*=42 (14G+28S), (genomic status *GGSSSS*)

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4. F1GO; IG-08-41 (IC0593643; INGR13038) Diploid Apomeiotic Interspecific Hybrid Between *P. glaucum* and *P. orientale*. Induced Apospory (Apomixes Component). Chromosomes *(GS)*

BC1GO; IG-08-39 (IC0593644; INGR13039) Interspecific Hybrid Derived from *P. glaucum* and *P. orientale* cross (a BIII Hybrid of F1 with *P. glaucum*). Exhibited Inheritable Partitioned Apomixes Components. Chromosomes 2*n*=23 (14G+90, Genomes *GGO*)

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Pearl millet is an important crop both for food and fodder purposes. Genepool of wild *Pennisetum* species offer opportunities to understand genome evolution, domestication, polyploidy effects and apomixis in addition to crop improvement utilizing alien introgressions. We've produced and analyzed interspecific hybrids between two diploid *Pennisetum* species, *viz. P. glaucum* (cultivated pearl millet, 2n=2x=14, *GG*) and its wild relative *P. orientale* (2n=2x=18, *OO*) (Zadoo and Singh, 1986, Kaushal *et al.,* 2010). Pearl millet is sexual in its mode of reproduction, whereas *P. orientale* is known to be sexual at diploid levels while apomictic in naturally occurring higher polyploids.

INGR13038: F_1 Hybrid (F1GO; IG 08-41)

The F_1 hybrid (=F1GO; IG 08-41) has been reported for the first time and is characterized by 2n=2x=16 chromosomes (genomic status *GO*), represented by 7G+9O chromosomes from respective parents, showing its origin from meiotically reduced gametes from both the parents. It was also supported by DNA content measurements using flow cytometry. The most interesting feature of this plant was modification in its mode of reproduction. Although both parents were sexual, this hybrid was apomeiotic. The parents were characterized by meiotically reduced sexual embryo-sacs (ES), while the hybrid produced apomictic (aposporous) and unreduced ES. This is the first report of induction of apomeiosis by hybridizing two sexual diploids, whereby a transition from 8-nucleated Polygonum type sexual ES to 4-nucleated Panicum type aposporous ES is demonstrated (Kaushal *et al*., 2010). Interspecific hybridization, alongwith polyploidy is believed to be a driving force for evolution of apomixis. We here provide evidence of this induction hypothesis in *Pennisetum*. This hybrid produced both sexual (4%) and aposporous ES (28%), however, on (cross) pollination yielded all triploid progeny (B_{III} hybrids) originating from fertilization of unreduced egg cell with reduced sperm cell. This also demonstrated uncoupling of apomeiosis from other two apomixis components (parthenogenesis and functional endosperm development). This plant (F1GO) also represent a rare example of diploid apomeiotic hybrid where other factors of apomixis regulation viz. parthenogenesis and polyploidy were absent. Additionally, it offers us a system to study interactions and modifications in the sexual genomes under hybrid background leading to components of apomixis. Detailed analysis of plant morphology, cytology and reproduction has been described (Kaushal *et al.,* 2010). The plant is strongly perennial, morphologically intermediate to both parents, male-sterile, moderately female fertile exhibiting facultative apomixis. Since the plant is male sterile, self-pollinated seeds can-not be obtained. Further, as it produces all B_{III} seeds on cross-pollination, the progeny would not be true-to-type, and hence needs maintenance by vegetative propagation. The plant respond excellent to multiplication via tillers and can be easily maintained. It will be maintained at IGFRI, Jhansi.

INGR13039: BC1 Hybrid (BC1GO; IG 08-39)

The F_1 hybrid (*viz.,* F1GO) was backcrossed with *P. glaucum* parent. The BC_1 thus obtained was designated as BC1GO (=IG 08-39) and is characterized by 2n=3x=23 chromosomes (genomic status *GGO*) with 14 chromosomes from *P. glaucum* and 9 chromosomes from *P. orientale*. Meiotic chromosomal analysis alongwith the flow cytometric DNA content measurements confirmed formation of this hybrid (BC1GO) combining unreduced female gamete (*GO*) and reduced male

gamete (*G*). This hybrid is cytologically unique to possess 2n=23 chromosomes with two monoploid genome doses from *P. glaucum* and a monoploid dose from *P. orientale*. The hybrid was facultative apomictic in mode of reproduction, producing 28% aposporous embryo sacs (ES) and 19% sexual ES (Kaushal *et al.,* 2010). Reproductive development in this hybrid is characterized by autonomous endosperm development (proliferation of polar nuclei in absence of pollination) as well as formation of all B_{III} seeds (unreduced egg cell fertilized) upon cross pollination. Independent existence of autonomous endosperm development as well as B_{III} hybridization provides evidence of partitioning of apomixis components for the first time in *Pennisetum*. Partitioned apomixis components were also inherited to subsequent generations. As BC1GO (=IG 08-39) produced only B_{III} seeds, it also represented a clear functional uncoupling of apomeiosis and parthenogenesis (the apomixis components). As this plant is characterized by partitioned apomixis components, showed autonomous endosperm development and produces only B_{III} seeds, it is a potential material for serially raising the ploidy levels as well as to identify genes responsible for apomeiotic (aposporous) ES formation and those involved in B_{III} hybridization events. Furthermore, owing to its capacity to produce B_{III} hybrids, this plant has been utilized to identify differentially expressed genes during apomeiosis. The plant is male sterile, however, is perennial and responds well to multiplication through rooted slips. It is being maintained at NAGS-IGFRI, Jhansi.

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5. GOSh8; IG-08-40 (IC0593645; INGR13040) a First Trispecific Hybrid between *Pennisetum glaucum, P. orientale* and *P. squamulatum*. Chromosomes 2*n*=44 (21G+14S+90, Genomes (*GGGSSO)*)

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Pennisetum is a genus representing high variability. It includes species belonging to 2x to 8x ploidy and basic chromosome number ranging from x=5 to 9. Interspecific hybridization in this genus, involving the cultivated species pearl millet (*P. glaucum*), has been attempted to study genome and polyploidy evolution as well as to transfer desirable traits for pearl millet improvement (Jauhar and Hanna 1989). A tri-species hybrid (GOS hybrids) in the genus *Pennisetum* is reported here, involving species *viz. P. glaucum*, *P. orientale* and *P. squamulatum* (Kaushal *et al.* 2010). The GOS hybrids were produced following a cross between interspecific hybrids BC1GO x GSH2. Where BC1GO (2n=3x=23, genomic status *GGO*) is a backcross hybrid obtained by [*P. glaucum* (2n=14, *GG*) x *P. orientale* (2n=18, *OO*)] x *P. glaucum* (2n=14) cross, while GSH2 is an apomictic F1 between *P. glaucum* (2n=4x=28, *GGGG*) x *P. squamulatum* (2n=8x=56, *SSSSSSSS*) (Kaushal *et al.* 2007). These GOS hybrids are reported for the first time, and combines genomes of the three species in a common background. Meiotic chromosomal and flow cytometric analyses revealed origin of these hybrids from unreduced female gametes and reduced male gametes. They were characterized by 2*n*=44 chromosomes (genomic status *GGGSSO*), having three monoploid doses of *P. glaucum*, two of *P. squamulatum* and one of *P. orientale*, represented by a total of 21, 14 and 9 chromosomes, respectively. The plants were male sterile but female fertile, and were highly aposporous (>66% aposporous embryo-sacs). Cytologically, limited inter-genomic pairing was observed demonstrating absence of significant genome homology between the species. Autonomous endosperm proliferation was frequently observed in ES of these hybrids. These hybrids offer system to understand genomic interactions between genomes of three contributing species onto various cytological, morphological and breeding traits, especially to understand genome homology and evolution in the genus *Pennisetum*. Furthermore, these hybrids offer system to understand regulation of apomixis and its

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Pennisetum is a genus representing high variability. It includes species belonging to 2x to 8x ploidy and basic chromosome number ranging from x=5 to 9. Interspecific hybridization in this genus, involving the cultivated species pearl millet (*P. glaucum*), has been attempted to study genome and polyploidy evolution as well as to transfer desirable traits for pearl millet improvement (Jauhar and Hanna 1989). A tri-species hybrid (GOS hybrids) in the genus *Pennisetum* is reported here, involving species *viz. P. glaucum*, *P. orientale* and *P. squamulatum* (Kaushal *et al.* 2010). The GOS hybrids were produced following a cross between interspecific hybrids BC1GO x GSH2. Where BC1GO (2n=3x=23, genomic status *GGO*) is a backcross hybrid obtained by [*P. glaucum* (2n=14, *GG*) x *P. orientale* (2n=18, *OO*)] x *P. glaucum* (2n=14) cross, while GSH2 is an apomictic F1 between *P. glaucum* (2n=4x=28, *GGGG*) x *P. squamulatum* (2n=8x=56, *SSSSSSSS*) (Kaushal *et al.* 2007). These GOS hybrids are reported for the first time, and combines genomes of the three species in a common background. Meiotic chromosomal and flow cytometric analyses revealed origin of these hybrids from unreduced female gametes and reduced male gametes. They were characterized by 2*n*=44 chromosomes (genomic status *GGGSSO*), having three monoploid doses of *P. glaucum*, two of *P. squamulatum* and one of *P. orientale*, represented by a total of 21, 14 and 9 chromosomes, respectively. The plants were male sterile but female fertile, and were highly aposporous (>66% aposporous embryo-sacs). Cytologically, limited inter-genomic pairing was observed demonstrating absence of significant genome homology between the species. Autonomous endosperm proliferation was frequently observed in ES of these hybrids. These hybrids offer system to understand genomic interactions between genomes of three contributing species onto various cytological, morphological and breeding traits, especially to understand genome homology and evolution in the genus *Pennisetum*. Furthermore, these hybrids offer system to understand regulation of apomixis and its

gamete (*G*). This hybrid is cytologically unique to possess 2n=23 chromosomes with two monoploid genome doses from *P. glaucum* and a monoploid dose from *P. orientale*. The hybrid was facultative apomictic in mode of reproduction, producing 28% aposporous embryo sacs (ES) and 19% sexual ES (Kaushal *et al.,* 2010). Reproductive development in this hybrid is characterized by autonomous endosperm development (proliferation of polar nuclei in absence of pollination) as well as formation of all B_{III} seeds (unreduced egg cell fertilized) upon cross pollination. Independent existence of autonomous endosperm development as well as B_{III} hybridization provides evidence of partitioning of apomixis components for the first time in *Pennisetum*. Partitioned apomixis components were also inherited to subsequent generations. As BC1GO (=IG 08-39) produced only B_{III} seeds, it also represented a clear functional uncoupling of apomeiosis and parthenogenesis (the apomixis components). As this plant is characterized by partitioned apomixis components, showed autonomous endosperm development and produces only B_{III} seeds, it is a potential material for serially raising the ploidy levels as well as to identify genes responsible for apomeiotic (aposporous) ES formation and those involved in B_{III} hybridization events. Furthermore, owing to its capacity to produce B_{III} hybrids, this plant has been utilized to identify differentially expressed genes during apomeiosis. The plant is male sterile, however, is perennial and responds well to multiplication through rooted slips. It is being maintained at NAGS-IGFRI, Jhansi.

References

Kaushal P, A Khare, SA Siddiqui, A Agrawal, S Paul, DR Malaviya, AK Roy and SN Zadoo (2010) Morphological, cytological and reproductive characterization of tri-species hybrids (GOS) between *Pennisetum glaucum*, *P. orientale* and *P. squamulatum*. *Euphytica* **174**: 261-281.

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5. GOSh8; IG-08-40 (IC0593645; INGR13040) a First Trispecific Hybrid between *Pennisetum glaucum, P. orientale* and *P. squamulatum*. Chromosomes 2*n*=44 (21G+14S+90, Genomes (*GGGSSO)*)

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components, specially the interaction between genes for apomeiosis (from BC1GO parent) and parthenogenesis (from GSH2 parent). One of these GOS tri-species hybrids, *viz*. GOSh8 (=accession IG 08-40) (Kaushal *et al*. 2010) showed better tillering and vigour than other siblings, and is proposed for registration. The hybrid is male sterile, however, could be easily multiplied by rooted slips. It is being maintained at NAGS-Forage Crops at IGFRI Jhansi.

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6. DGS-22 (IC0590889; INGR13041) a High Fruit Producing Madhunashini (*Gymnema sylvestre*)

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7. DMAPR AP3; NRC AP3 (IC0593956; INGR13042) a Kalmegh (*Andrographis paniculata*) Germplasm with Narrow Leaf Very High Andrographoloide (2.97%)

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8. DMAPR AB1 (IC0283932; INGR13043) is a Aloe (*Aloe bardadensis)* Yellow Flowered Plant Type

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9. NRC CW2 (IC0593954; INGR13044) a Guggal (*Comiphora wrightii*) Male Plant of Divergent/Erect Branch

10. NRC CW1 (IC0593955; INGR13045) is a Weeping Branch Type Female Plant of Guggal (*Comiphora wrightii*)

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11. NKO-68 (IC589087/INGR13046) Oregano (*Origanum vulgare*) for High Percentage of Phenolic Compound Thymol and High Yield of Essential Oil

KS Negi[1], SN Ojha[1], SS Koranga[1], AKS Rawat[2], MM Pandey[2]and Archana P Raina[3]
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Oregano (*Origanum vulgare* L.) is an important member of mint family, Lamiaceae. The genus *Origanum* comprises about 39 species, most of which are indigenous to the Mediterranean region and distributed all over Europe, West and Central Asia upto Taiwan. In India the herb is found in the temperate Himalayas from Kashmir to Sikkim between 1000- 3600 m asl. It is widely distributed in open forest, open scrub of hilly districts of Kumaun and Garhwal region of Uttarakhand and Himachal Pradesh. It is known locally as Van tulsi, Sathra, Vishnu Priya, Jakhmbuti and Baslo ghas etc. *Origanum vulgare L.* commonly known as 'Oregano' in the most of European countries and in India it is known as 'Himalayan Marjoram'.

During the project period (April, 2008- June, 2012) entitled "Studies on relationship between ecogeography of the chemotypic variation of nine important but highly threatened medicinal plant species and prospects of their cultivation" financed by NAIP-IV, a total of 34 accessions of oregano was collected from North-West Himalaya, Central Himalayan Region and North- East Hills of India and identified a superior chemotype i.e., Thymol rich and high yielding essential oil. The Oregano germplasm (NKO-68/ IC 589087) was collected and identified from on way to Vashudhara fall from Sh. Badarinath shrine, District- Chamoli, Uttarakhand. It was successfully raised and thrives well with luxuriant growth in Field Gene Bank/ Herbal Garden, NBPGR, R/S Bhowali, Nainital, Uttarakhand. High Thymol content (85.87%) was observed from essential oil isolated from aerial part and high yield of essential oil (2.07%) was reported during flowering stage (Anonymous, 2010; Negi, *et al*., 2011).

Morpho-agronomic Characteristics

It is aromatic, branched, perennial, 30-60 cm. high. Leaves are dark green, broadly ovate; and ; stem light green, pubescent, soft woody; bracts purple and flowers pale- pink colour, flowers are in terminal corymbose cyme, The herb contains a high yield of essential oil (2.07%) and rich phenolic compound – Thymol (85.87%) –Table 1 and 2.

Table 1. Comparative analysis of thymol and percentage of essential oil in 30 accession of *Origanum vulgare*

S. No.	Collector number	IC No.	Essential oil (%)	Thymol (%)
1	NMB- 2955	IC566859	0.5	1.51
2	***NKO-09 (Local check)**	**IC573209**	**0.17**	**16.78**
3	NMVM KO 14	IC573213	0.86	1.52
4	NKO- 15	IC573214	1.06	3.95
5	NKO- 16	IC573215	0.7	32.16
6	NKO- 17	IC573216	1.43	53.5
7	NKO- 18	IC573217	1.41	37.34
8	NKO- 19	IC573218	1.2	26.31
9	NKO- 20	IC573219	2	28.26
10	NKO- 21	IC573220	0.22	5.99
11	****NKO- 25**	**IC573224**	**0.4**	**0.42**
12	NKO- 26	IC573225	0.4	4.86
13	NKO-30	IC573229	0.88	30.74
14	NKO- 45	IC574508	0.4	7.12
15	NKO- 49	IC574512	0.48	2.51
16	NKO- 50	IC574513	1.5	38.92
17	NKO- 56	IC574518	1.25	51.45
18	NKO-57	IC574519	1.31	42.68
19	NKO- 58	IC574520	1.7	45.61
20	NMJO-2983	IC582500	0.67	2.74
21	NMJO-2993	IC582510	0.48	29.42
22	NMJO- 3004	IC582521	0.9	45.19
23	NMO 3015	IC582532	0.44	3.06
24	NMO- 3019	IC582536	0.6	2.17
25	MMBO-3040	IC589077	0.57	12.9
26	MMBO-3055	IC589079	1.41	21.38
27	NKO-64	IC589084	0.29	6.02
28	NKO-65	IC589085	0.98	81.45
29	****NKO-68**	**IC589087**	**2.07**	**85.87**
30	NKO-72	IC589090	0.32	9.02
Range of variation			**0.17-2.07**	**0.42-85.87**
Average			**0.89**	**24.36**

*NKO-09/ IC573209 Local check
**NKO- 25/ IC573224 Lowest percentage of thymol
***NKO-68/ IC589087 Thymol rich and high essential oil yield genotype

Table 2. Percentage of essential oil and thymol in aerial parts of different *Origanum vulgare* L. strains

Items	*Origanum vulgare* (NKO-68/IC589087)	*O. vulgare* (Kumaon Himalya) Verma *et al.* (2010)	*O. vulgare* (Jageshwar, Almora, UK) Raina A *et al.* (2010)	Origanum species (Greek) Wogiatzi, (2009)	*O. vulgare* Lithuania, Mockute *et al.* (2004)	*O. vulgare* ssp. *vulgare* (Vilnius district-Lithuania) Mockute *et al.* (2001)	*O. vulgare* ssp. *vulgare* (Italy) Melegari *et al.* (1995)
Essential oil extracted from aerial parts (dried) (%)	**2.07**	0.25-1.30	0.14-0.37	0.3-0.4	NR	*NR	*NR
Thymol (%)	**85.87**	0.37-0.70	33.92	57.2	0.0-3.2	0.1-0.5	39.3

*NR – Not Reported

Associated Characters and Cultivated Practices

The herb occurs abundantly under pine forest, near scrub forest, open scrubs and near agricultural land in the sub-tropical, temperate and alpine Himalayan region at an elevation of 1100- 3600 m asl. Oregano was propagated by seeds, stem cuttings and sprouted root divisions successfully. The herbage was harvested after rainy season and dried in shade for its natural green colour and fragrance. A total of 6-8 q/ha dried aerial parts obtained. The market price of dry herbage is Rs. 200/- to 250/- per kg. Total return from dried herbage is Rs. 1.0- to 1.2 lakh annually.

It has various ethno botanical notes and much popular in traditional medicinal systems for the treatment of cold, cough, fever, cuts in heal, diarrhoea, ear ache, flavoring agent, healing wounds, insect repellent, inflammation, local beverage, herbal tea, aesthetic purpose and skin diseases.

The present genetic stock of *Origanum vulgare L.* germplasm **NKO-68/ IC589087** showed Thymol rich and high yield of essential oil as compared to other accessions including local check collected from Central Himalayan region (Table 1 and 2).

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12. DWS-6 (IC0590838; INGR13047) a New Plant Type of Ashwagandha (*Withania somnifera*) which is a Unique and Distinct than Normal Erect Type

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4	NKO- 15	IC573214	1.06	3.95
5	NKO- 16	IC573215	0.7	32.16
6	NKO- 17	IC573216	1.43	53.5
7	NKO- 18	IC573217	1.41	37.34
8	NKO- 19	IC573218	1.2	26.31
9	NKO- 20	IC573219	2	28.26
10	NKO- 21	IC573220	0.22	5.99
11	****NKO- 25**	**IC573224**	**0.4**	**0.42**
12	NKO- 26	IC573225	0.4	4.86
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14	NKO- 45	IC574508	0.4	7.12
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27	NKO-64	IC589084	0.29	6.02
28	NKO-65	IC589085	0.98	81.45
29	****NKO-68**	**IC589087**	**2.07**	**85.87**
30	NKO-72	IC589090	0.32	9.02
Range of variation			**0.17-2.07**	**0.42-85.87**
Average			**0.89**	**24.36**

*NKO-09/ IC573209 Local check
**NKO- 25/ IC573224 Lowest percentage of thymol
***NKO-68/ IC589087 Thymol rich and high essential oil yield genotype

Table 2. Percentage of essential oil and thymol in aerial parts of different *Origanum vulgare* L. strains

Items	*Origanum vulgare* (NKO-68/IC589087)	*O. vulgare* (Kumaon Himalya) Verma *et al.* (2010)	*O. vulgare* (Jageshwar, Almora, UK) Raina A *et al.* (2010)	Origanum species (Greek) Wogiatzi, (2009)	*O. vulgare* Lithuania, Mockute *et al.* (2004)	*O. vulgare* ssp. *vulgare* (Vilnius district-Lithuania) Mockute *et al.* (2001)	*O. vulgare* ssp. *vulgare* (Italy) Melegari *et al.* (1995)
Essential oil extracted from aerial parts (dried) (%)	**2.07**	0.25-1.30	0.14-0.37	0.3-0.4	NR	*NR	*NR
Thymol (%)	**85.87**	0.37-0.70	33.92	57.2	0.0-3.2	0.1-0.5	39.3

*NR – Not Reported

Associated Characters and Cultivated Practices

The herb occurs abundantly under pine forest, near scrub forest, open scrubs and near agricultural land in the sub-tropical, temperate and alpine Himalayan region at an elevation of 1100- 3600 m asl. Oregano was propagated by seeds, stem cuttings and sprouted root divisions successfully. The herbage was harvested after rainy season and dried in shade for its natural green colour and fragrance. A total of 6-8 q/ha dried aerial parts obtained. The market price of dry herbage is Rs. 200/- to 250/- per kg. Total return from dried herbage is Rs. 1.0- to 1.2 lakh annually.

It has various ethno botanical notes and much popular in traditional medicinal systems for the treatment of cold, cough, fever, cuts in heal, diarrhoea, ear ache, flavoring agent, healing wounds, insect repellent, inflammation, local beverage, herbal tea, aesthetic purpose and skin diseases.

The present genetic stock of *Origanum vulgare L.* germplasm **NKO-68/ IC589087** showed Thymol rich and high yield of essential oil as compared to other accessions including local check collected from Central Himalayan region (Table 1 and 2).

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12. DWS-6 (IC0590838; INGR13047) a New Plant Type of Ashwagandha (*Withania somnifera*) which is a Unique and Distinct than Normal Erect Type

P Manivel, NA Gajbhiye and S Maiti

Directorate of Medicinal & Aromatic Plants Research, Boriavi, Anand-387 310, Gujarat
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components, specially the interaction between genes for apomeiosis (from BC1GO parent) and parthenogenesis (from GSH2 parent). One of these GOS tri-species hybrids, *viz*. GOSh8 (=accession IG 08-40) (Kaushal *et al*. 2010) showed better tillering and vigour than other siblings, and is proposed for registration. The hybrid is male sterile, however, could be easily multiplied by rooted slips. It is being maintained at NAGS-Forage Crops at IGFRI Jhansi.

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6. DGS-22 (IC0590889; INGR13041) a High Fruit Producing Madhunashini (*Gymnema sylvestre*)

P Manivel, Saravanan Raju, Sandip Kumar L Patel and S Maiti
Directorate of Medicinal & Aromatic Plants Research, Boriavi, Anand-387 310, Gujarat
(E-mail: manivelp@yahoo.com)

7. DMAPR AP3; NRC AP3 (IC0593956; INGR13042) a Kalmegh (*Andrographis paniculata*) Germplasm with Narrow Leaf Very High Andrographoloide (2.97%)

Geetha KA, S Maiti, Narendra Gajbhiye, Arun Kumar PH and Anjali Sharma
Directorate of Medicinal & Aromatic Plants Research, Boriavi, Anand-387 310, Gujarat
(E-mail: geethaka99@yahoo.com)

8. DMAPR AB1 (IC0283932; INGR13043) is a Aloe (*Aloe bardadensis)* Yellow Flowered Plant Type

Geetha KA, S Maiti, Narendra Gajbhiye and Sanghamitra Saman
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9. NRC CW2 (IC0593954; INGR13044) a Guggal (*Comiphora wrightii*) Male Plant of Divergent/Erect Branch

10. NRC CW1 (IC0593955; INGR13045) is a Weeping Branch Type Female Plant of Guggal (*Comiphora wrightii*)

Geetha KA, S Maiti, Narendra Gajbhiye, AK Bishoyi and Anjali Sharma
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11. NKO-68 (IC589087/INGR13046) Oregano (*Origanum vulgare*) for High Percentage of Phenolic Compound Thymol and High Yield of Essential Oil

KS Negi[1], SN Ojha[1], SS Koranga[1], AKS Rawat[2], MM Pandey[2]and Archana P Raina[3]
[1]*NBPGR, Regional Station Bhowali- 263132, Niglat, District Nainital, Uttarakhand*
[2]*National Botanical Research Institute (CSIR), Lucknow-226001, Uttar Pradesh*
[3]*NBPGR, Pusa Campus, New Delhi-110012*
(E-mail: officerinchargebhowali@yahoo.com)

Oregano (*Origanum vulgare* L.) is an important member of mint family, Lamiaceae. The genus *Origanum* comprises about 39 species, most of which are indigenous to the Mediterranean region and distributed all over Europe, West and Central Asia upto Taiwan. In India the herb is found in the temperate Himalayas from Kashmir to Sikkim between 1000- 3600 m asl. It is widely distributed in open forest, open scrub of hilly districts of Kumaun and Garhwal region of Uttarakhand and Himachal Pradesh. It is known locally as Van tulsi, Sathra, Vishnu Priya, Jakhmbuti and Baslo ghas etc. *Origanum vulgare L.* commonly known as 'Oregano' in the most of European countries and in India it is known as 'Himalayan Marjoram'.

During the project period (April, 2008- June, 2012) entitled "Studies on relationship between ecogeography of the chemotypic variation of nine important but highly threatened medicinal plant species and prospects of their cultivation" financed by NAIP-IV, a total of 34 accessions of oregano was collected from North-West Himalaya, Central Himalayan Region and North- East Hills of India and identified a superior chemotype i.e., Thymol rich and high yielding essential oil. The Oregano germplasm (NKO-68/ IC 589087) was collected and identified from on way to Vashudhara fall from Sh. Badarinath shrine, District- Chamoli, Uttarakhand. It was successfully raised and thrives well with luxuriant growth in Field Gene Bank/ Herbal Garden, NBPGR, R/S Bhowali, Nainital, Uttarakhand. High Thymol content (85.87%) was observed from essential oil isolated from aerial part and high yield of essential oil (2.07%) was reported during flowering stage (Anonymous, 2010; Negi, *et al*., 2011).

Morpho-agronomic Characteristics

It is aromatic, branched, perennial, 30-60 cm. high. Leaves are dark green, broadly ovate; and ; stem light green, pubescent, soft woody; bracts purple and flowers pale- pink colour, flowers are in terminal corymbose cyme, The herb contains a high yield of essential oil (2.07%) and rich phenolic compound – Thymol (85.87%) –Table 1 and 2.

Table 1. Comparative analysis of thymol and percentage of essential oil in 30 accession of *Origanum vulgare*

S. No.	Collector number	IC No.	Essential oil (%)	Thymol (%)
1	NMB- 2955	IC566859	0.5	1.51
2	***NKO-09 (Local check)**	**IC573209**	**0.17**	**16.78**
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Range of variation			**0.17-2.07**	**0.42-85.87**
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Essential oil extracted from aerial parts (dried) (%)	**2.07**	0.25-1.30	0.14-0.37	0.3-0.4	NR	*NR	*NR
Thymol (%)	**85.87**	0.37-0.70	33.92	57.2	0.0-3.2	0.1-0.5	39.3

*NR – Not Reported

Associated Characters and Cultivated Practices

The herb occurs abundantly under pine forest, near scrub forest, open scrubs and near agricultural land in the sub-tropical, temperate and alpine Himalayan region at an elevation of 1100- 3600 m asl. Oregano was propagated by seeds, stem cuttings and sprouted root divisions successfully. The herbage was harvested after rainy season and dried in shade for its natural green colour and fragrance. A total of 6-8 q/ha dried aerial parts obtained. The market price of dry herbage is Rs. 200/- to 250/- per kg. Total return from dried herbage is Rs. 1.0- to 1.2 lakh annually.

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Table 2. Percentage of essential oil and thymol in aerial parts of different *Origanum vulgare* L. strains

Items	*Origanum vulgare* (NKO-68/IC589087)	*O. vulgare* (Kumaon Himalya) Verma *et al.* (2010)	*O. vulgare* (Jageshwar, Almora, UK) Raina A *et al.* (2010)	Origanum species (Greek) Wogiatzi, (2009)	*O. vulgare* Lithuania, Mockute *et al.* (2004)	*O. vulgare* ssp. *vulgare* (Vilnius district-Lithuania) Mockute *et al.* (2001)	*O. vulgare* ssp. *vulgare* (Italy) Melegari *et al.* (1995)
Essential oil extracted from aerial parts (dried) (%)	**2.07**	0.25-1.30	0.14-0.37	0.3-0.4	NR	*NR	*NR
Thymol (%)	**85.87**	0.37-0.70	33.92	57.2	0.0-3.2	0.1-0.5	39.3

*NR – Not Reported

Associated Characters and Cultivated Practices

The herb occurs abundantly under pine forest, near scrub forest, open scrubs and near agricultural land in the sub-tropical, temperate and alpine Himalayan region at an elevation of 1100- 3600 m asl. Oregano was propagated by seeds, stem cuttings and sprouted root divisions successfully. The herbage was harvested after rainy season and dried in shade for its natural green colour and fragrance. A total of 6-8 q/ha dried aerial parts obtained. The market price of dry herbage is Rs. 200/- to 250/- per kg. Total return from dried herbage is Rs. 1.0- to 1.2 lakh annually.

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P Manivel, NA Gajbhiye and S Maiti

Directorate of Medicinal & Aromatic Plants Research, Boriavi, Anand-387 310, Gujarat
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components, specially the interaction between genes for apomeiosis (from BC1GO parent) and parthenogenesis (from GSH2 parent). One of these GOS tri-species hybrids, *viz*. GOSh8 (=accession IG 08-40) (Kaushal *et al*. 2010) showed better tillering and vigour than other siblings, and is proposed for registration. The hybrid is male sterile, however, could be easily multiplied by rooted slips. It is being maintained at NAGS-Forage Crops at IGFRI Jhansi.

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6. DGS-22 (IC0590889; INGR13041) a High Fruit Producing Madhunashini (*Gymnema sylvestre*)

P Manivel, Saravanan Raju, Sandip Kumar L Patel and S Maiti
Directorate of Medicinal & Aromatic Plants Research, Boriavi, Anand-387 310, Gujarat
(E-mail: manivelp@yahoo.com)

7. DMAPR AP3; NRC AP3 (IC0593956; INGR13042) a Kalmegh (*Andrographis paniculata*) Germplasm with Narrow Leaf Very High Andrographoloide (2.97%)

Geetha KA, S Maiti, Narendra Gajbhiye, Arun Kumar PH and Anjali Sharma
Directorate of Medicinal & Aromatic Plants Research, Boriavi, Anand-387 310, Gujarat
(E-mail: geethaka99@yahoo.com)

8. DMAPR AB1 (IC0283932; INGR13043) is a Aloe (*Aloe bardadensis)* Yellow Flowered Plant Type

Geetha KA, S Maiti, Narendra Gajbhiye and Sanghamitra Saman
Directorate of Medicinal & Aromatic Plants Research, Boriavi, Anand-387 310, Gujarat
(E-mail: geethaka99@yahoo.com)

9. NRC CW2 (IC0593954; INGR13044) a Guggal (*Comiphora wrightii*) Male Plant of Divergent/Erect Branch

10. NRC CW1 (IC0593955; INGR13045) is a Weeping Branch Type Female Plant of Guggal (*Comiphora wrightii*)

Geetha KA, S Maiti, Narendra Gajbhiye, AK Bishoyi and Anjali Sharma
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11. NKO-68 (IC589087/INGR13046) Oregano (*Origanum vulgare*) for High Percentage of Phenolic Compound Thymol and High Yield of Essential Oil

KS Negi[1], SN Ojha[1], SS Koranga[1], AKS Rawat[2], MM Pandey[2]and Archana P Raina[3]
[1]*NBPGR, Regional Station Bhowali- 263132, Niglat, District Nainital, Uttarakhand*
[2]*National Botanical Research Institute (CSIR), Lucknow-226001, Uttar Pradesh*
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Oregano (*Origanum vulgare* L.) is an important member of mint family, Lamiaceae. The genus *Origanum* comprises about 39 species, most of which are indigenous to the Mediterranean region and distributed all over Europe, West and Central Asia upto Taiwan. In India the herb is found in the temperate Himalayas from Kashmir to Sikkim between 1000- 3600 m asl. It is widely distributed in open forest, open scrub of hilly districts of Kumaun and Garhwal region of Uttarakhand and Himachal Pradesh. It is known locally as Van tulsi, Sathra, Vishnu Priya, Jakhmbuti and Baslo ghas etc. *Origanum vulgare L.* commonly known as 'Oregano' in the most of European countries and in India it is known as 'Himalayan Marjoram'.

During the project period (April, 2008- June, 2012) entitled "Studies on relationship between ecogeography of the chemotypic variation of nine important but highly threatened medicinal plant species and prospects of their cultivation" financed by NAIP-IV, a total of 34 accessions of oregano was collected from North-West Himalaya, Central Himalayan Region and North- East Hills of India and identified a superior chemotype i.e., Thymol rich and high yielding essential oil. The Oregano germplasm (NKO-68/ IC 589087) was collected and identified from on way to Vashudhara fall from Sh. Badarinath shrine, District- Chamoli, Uttarakhand. It was successfully raised and thrives well with luxuriant growth in Field Gene Bank/ Herbal Garden, NBPGR, R/S Bhowali, Nainital, Uttarakhand. High Thymol content (85.87%) was observed from essential oil isolated from aerial part and high yield of essential oil (2.07%) was reported during flowering stage (Anonymous, 2010; Negi, *et al*., 2011).

Morpho-agronomic Characteristics

It is aromatic, branched, perennial, 30-60 cm. high. Leaves are dark green, broadly ovate; and ; stem light green, pubescent, soft woody; bracts purple and flowers pale- pink colour, flowers are in terminal corymbose cyme, The herb contains a high yield of essential oil (2.07%) and rich phenolic compound – Thymol (85.87%) –Table 1 and 2.

Table 1. Comparative analysis of thymol and percentage of essential oil in 30 accession of *Origanum vulgare*

S. No.	Collector number	IC No.	Essential oil (%)	Thymol (%)
1	NMB- 2955	IC566859	0.5	1.51
2	***NKO-09 (Local check)**	**IC573209**	**0.17**	**16.78**
3	NMVM KO 14	IC573213	0.86	1.52
4	NKO- 15	IC573214	1.06	3.95
5	NKO- 16	IC573215	0.7	32.16
6	NKO- 17	IC573216	1.43	53.5
7	NKO- 18	IC573217	1.41	37.34
8	NKO- 19	IC573218	1.2	26.31
9	NKO- 20	IC573219	2	28.26
10	NKO- 21	IC573220	0.22	5.99
11	****NKO- 25**	**IC573224**	**0.4**	**0.42**
12	NKO- 26	IC573225	0.4	4.86
13	NKO-30	IC573229	0.88	30.74
14	NKO- 45	IC574508	0.4	7.12
15	NKO- 49	IC574512	0.48	2.51
16	NKO- 50	IC574513	1.5	38.92
17	NKO- 56	IC574518	1.25	51.45
18	NKO-57	IC574519	1.31	42.68
19	NKO- 58	IC574520	1.7	45.61
20	NMJO-2983	IC582500	0.67	2.74
21	NMJO-2993	IC582510	0.48	29.42
22	NMJO- 3004	IC582521	0.9	45.19
23	NMO 3015	IC582532	0.44	3.06
24	NMO- 3019	IC582536	0.6	2.17
25	MMBO-3040	IC589077	0.57	12.9
26	MMBO-3055	IC589079	1.41	21.38
27	NKO-64	IC589084	0.29	6.02
28	NKO-65	IC589085	0.98	81.45
29	****NKO-68**	**IC589087**	**2.07**	**85.87**
30	NKO-72	IC589090	0.32	9.02
Range of variation			**0.17-2.07**	**0.42-85.87**
Average			**0.89**	**24.36**

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Table 2. Percentage of essential oil and thymol in aerial parts of different *Origanum vulgare* L. strains

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The herb occurs abundantly under pine forest, near scrub forest, open scrubs and near agricultural land in the sub-tropical, temperate and alpine Himalayan region at an elevation of 1100- 3600 m asl. Oregano was propagated by seeds, stem cuttings and sprouted root divisions successfully. The herbage was harvested after rainy season and dried in shade for its natural green colour and fragrance. A total of 6-8 q/ha dried aerial parts obtained. The market price of dry herbage is Rs. 200/- to 250/- per kg. Total return from dried herbage is Rs. 1.0- to 1.2 lakh annually.

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The herb occurs abundantly under pine forest, near scrub forest, open scrubs and near agricultural land in the sub-tropical, temperate and alpine Himalayan region at an elevation of 1100- 3600 m asl. Oregano was propagated by seeds, stem cuttings and sprouted root divisions successfully. The herbage was harvested after rainy season and dried in shade for its natural green colour and fragrance. A total of 6-8 q/ha dried aerial parts obtained. The market price of dry herbage is Rs. 200/- to 250/- per kg. Total return from dried herbage is Rs. 1.0- to 1.2 lakh annually.

It has various ethno botanical notes and much popular in traditional medicinal systems for the treatment of cold, cough, fever, cuts in heal, diarrhoea, ear ache, flavoring agent, healing wounds, insect repellent, inflammation, local beverage, herbal tea, aesthetic purpose and skin diseases.

The present genetic stock of *Origanum vulgare L.* germplasm **NKO-68/ IC589087** showed Thymol rich and high yield of essential oil as compared to other accessions including local check collected from Central Himalayan region (Table 1 and 2).

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12. DWS-6 (IC0590838; INGR13047) a New Plant Type of Ashwagandha (*Withania somnifera*) which is a Unique and Distinct than Normal Erect Type

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13. SS1735-02 (IC0594469; INGR13048) a Hexaploid Wild Potato Clone (*Solanum demissum*) with High Resistance against Late Blight and Low Cold Induced Sweetening even after 6 Months of Cold Storage (2-4ºC)

Vinay Bhardwaj[1], SK Luthra[2], Dalamu[1], Bir Pal Singh[1], Vinod Kumar[3], Dinesh Kumar[4] and Sanjeev Sharma[1]

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The genetic stock, 'SS 1735-02' is an elite clone of wild potato species *Solanum demissum* (2n=6x; 4 EBN) possessing a unique set of quantitative traits i.e. very high resistance against late blight and low cold induced sweetening even after 6 months' cold storage. True Potato Seed (TPS) of *Solanum demissum* accession GLKS-269 was introduced from Institute of Plant Genetics and Crop Plant Research (GLKS), Gross Luessewitz, Germany during the year 2000. Further conversion into tuber form and selections were undertaken at Central Potato Research Institute, Shimla and SS 1735-02 is one of the superior clone selected from GLKS-269.

Late blight caused by *Phytophthora infestans* is the most important biotic stress of potato worldwide causing more than USD 13 million losses annually in the developing countries alone. The most effective and environmentally safe means to defeat *P. infestans* is by incorporation of resistance genes from new sources of wild potato species. Processed potatoes are one of the most important value-added commodities. Low reducing sugars (<100mg/100 g fresh tuber weight) and high dry matter (>20%) are basic requirements for processing tubers into chips/ French fries. Harvested tubers are cold stored (at 2-4ºC) for year round availability of potatoes for table/ processing purposes. The long term cold storage results in excessive accumulation of reducing sugars imparting sweetening known as 'cold induced sweetening'. In cultivated potato, there is little variability for reducing sugar content after cold storage and few genotypes are suitable for cold chipping (Bhardwaj *et al*, 2011). SS 1735-02 maintains low reducing sugar (glucose < 50mg/ 100 Fwt.) and superior chip colour compared to processing varieties Atlantic, Kufri Chipsona-1 and Kufri Chipsona-3 even after 6 months of cold storage and without reconditioning (Luthra *et al*, 2009). Besides, this genotype is highly resistant (lesion area < 1.0 cm^2) in laboratory as well as under natural epiphytotic conditions against complex races of *P. infestans* (Gopal *et al*., 2008). This elite wild potato clone has short plant height, open canopy with red-brown stem, blue violet flowers, moderate flowering and high pollen fertility. The genotype possesses acceptable tuber traits with purple, smooth skin, oblong tubers with shallow eyes.

This genetic stock holds promise to exploit the resistance genes to low cold induced sweetening and late blight resistance in cultivated potato by hybridization through bridge species like *S. phureja* and thus will be helpful in strengthening the breeding programme for developing cultivars possessing both the quantitative traits.

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13. SS1735-02 (IC0594469; INGR13048) a Hexaploid Wild Potato Clone (*Solanum demissum*) with High Resistance against Late Blight and Low Cold Induced Sweetening even after 6 Months of Cold Storage (2-4ºC)

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14. MP/97-921(IC0594469; INGR13048) an Elite Potato (*Solanum tuberosum* ssp. *tuberosum*) Germplasm with Superior Processing Traits and High Resistance to Late Blight and Potato Virus-Y

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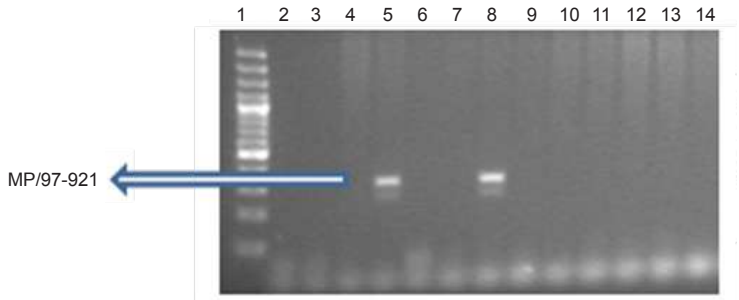
MP/97-921 is a potato (*Solanum tuberosum* ssp. *tuberosum*) hybrid developed from cross between MP/92-154 X MP/91-65 following the recurrent breeding selection method at Central Potato Research Institute, Shimla, Himachal Pradesh. This hybrid has high dry matter content, acceptable chip colour (score < 2), low reducing sugars & sucrose, maintains acceptable sugar level for six months storage at 10-12° C with CIPC treatment, acceptable amino acid and phenol content (Table 1.) with high resistance to late blight (Thakur *et al*., 2007) and potato virus Y (Fig.1).

The plant is tall with semi-compact canopy, stem thin, predominantly green with red-brown pigment lightly scattered throughout, wings highly developed and straight. The leaves are intermediate, leaflet narrow and rachis and midrib pigmentation absent. White coloured flowers with moderate flowering. Tubers are round-oval, white to creamy skin, eyes shallow, flesh cream pale yellow. Hybrid is medium maturing and yields 37.7 t/ha with 70-75 % processing grade (>45 mm dia.) tubers in plains and 23.5 t/ha and 71-76% processing grade in hills (Singh *et al.,* 2005). Considering its best performance

Table 1: Processing qualities of advanced hybrid MP/97-921 at Modipuram

Hybrid/Variety	Dry matter (%)	Chip colour score*	Reducing sugars**	Sucrose**	Total free amino acids **	Phenols**
MP/97-921	23.31	1.81	33.21	161.91	808.94	15.66
Kufri Chipsona-1	21.28	1.13	25.66	176.35	926.91	15.26
Atlantic	20.97	2.02	38.44	177.10	852.84	15.65

* = 1 to 9 scale (1 = lightest and 9 = darkest); ** mg/100 g fresh weight



Lane 1, Marker; Lane 2-14: K. Lalima, K. Badshah, K. Girdhari, MP/97-921, K. Sheetman, K. Megha, MP/04-578, CP 1765, CP 2407, CP 2011, MP/98-172, MP/05-05 and MP/05-41

Fig. 1: Presence of Ryadg gene imparting extreme resistance to PVY

for different quality parameters as well as resistance against late blight and potato virus Y this hybrid can be used as a suitable parent for developing superior potato varieties for processing and resistance breeding.

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15. SBIEC11004 (IC0594464; INGR13050) a Sugarcane *Erianthus* Clone with High fiber content: 30.21%

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SBIEC 11004 was developed from cross between IK 76-92 (*Erianthus arundinaceus*) and 98 N1 1405 (interspecific hybrid involving *Saccharum officinarum* and *Saccharum spontaneum*) for introgressing high fibre content from the parent IK 76-92. The clone was selected through hybridization and clonal selection method at Sugarcane Breeding Institute, Coimbatore. INGR 13050 is one of the potential high fibre energy cane with the highest cane fibre content of 30.21 % which is more than 120 % higher than the commercial sugarcane varieties presently cultivated. It also recorded high harvestable biomass/year of 193.83 t/ha and 75.94 t/ha of dry matter production/year (Govindaraj, 2011). The clone is a high yielding, fast growing, high tillering and thick cylindrical canes without wax coating and amenable for multiple ratooning. Bud is small and pentagonal in shape. Leaf sheath is green with smooth hairs and dewlap is absent. Under the abiotic stress conditions also it can perform well.

Sugar factories with cogeneration facility require more and continuous supply of bagasse to generate electricity through out the year. Present day cultivars have 13-15 % fibre content and available for crushing for about 200 days per year. The clone can be utilized for the establishment of energy plantations for supply of biomass. This is also a potential alternate raw materials to wood pulp in the paper industries.

Table: Performance of SBIEC 11001 for energy cane traits

Clone	Harvestable biomass t/ha	Fibre (% cane)	Juice brix (%)	Dry matter (%)	Dry matter yield (t/ha)
SBIEC 11004	193.83	30.21	7.80	39.18	75.94
IA 1167	208.95	22.56	16.88	35.53	74.25
SBIEC 11005	181.79	25.55	16.60	39.88	72.50
SBIEC 11006	197.22	25.77	11.00	35.24	69.50
IA 3135	160.49	23.48	17.51	37.88	60.80
SBIEC 11007	191.05	25.91	8.09	29.38	56.13
ISH 100	145.24	16.44	18.21	23.34	33.90

Reference

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ERRATUM: In Indian Journal of Plant Genetic Resources: 26(2) 2013 on page 190, the title no. 24 should be read as WF Sarson of yellow Sarson (*Brasica rapa* var. Yellow Sarson) instead of WF Yellow Sarson an Indian Mustard (*Brasica rapa*).

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