Morphological characterization of mutant lines of Nagina22 in rice (*Oryza sativa* L.)

N. P. Sakthi Avinash, K. Manonmani, R. Muthuvijayaragavan, S. Rajeswari, S. Manonmani, M. Raveendran and P. Jeyaprakash

ISSN: 0975-928X

Volume: 10

Number:2

EJPB (2019) 10(2):559-565

DOI:10.5958/0975-928X.2019.00070.X

https://ejplantbreeding.org

Electronic Journal of Plant Breeding, 10 (2): 559-565 (Jun 2019) DOI: 10.5958/0975-928X.2019.00070.X
ISSN 0975-928X

Research Article

Morphological characterization of mutant lines of Nagina22 in rice (*Oryza sativa* L.)

N. P. Sakthi Avinash[1], K. Manonmani[1], R. Muthuvijayaragavan[1], S. Rajeswari[2]*, S. Manonmani[3], M. Raveendran[4] and P. Jeyaprakash[5]
[1]Department of Rice, Centre for Plant Breeding and Genetics, TNAU, Coimbatore,
[2]Department of Cotton, Centre for Plant Breeding and Genetics, TNAU, Coimbatore,
[3]Department of PGR, Centre for Plant Breeding and Genetics, TNAU, Coimbatore,
[4]Department of Plant Biotechnology, Centre for Plant Molecular Biology, TNAU, Coimbatore
[5]Department of Plant Breeding and Genetics, ADAC and RI, Tiruchirappalli
***E-Mail:** rajisundar93@gmail.com

(Received: 09 May 2019; Revised: 01 Jun 2019; Accepted: 03 Jun 2019)

Abstract

Rice plays a major role in feeding more than half of the world`s population with total production of about 769.9 million tonnes all over the world. India is an inland to vast varieties of rice cultivars, landraces and many lesser known varieties that have been cultivated by farmers as well as local promoters. These cultivars were refined through selection depend on enticing characters such as grain yield, grain length, cooking quality, aroma and refitting to various abiotic stresses. Collection, preservation and characterization of such cultivars may provide great opportunity to utilize them in crop improvement. A set of 542 Nagina 22 mutants were morphologically characterized under DUS test guidelines and compared with Nagina 22 as a check variety. Characterization has confirmed the existence of Distinctness, Uniqueness and Stability for the traits studied as given in the guidelines. Based on this research highly distinguish rice genotypes would be opt for forwarding this to further generation and registration as farmers variety. And these genotypes can also be used in crop improvement event in terms of both quality traits and high yield even as source or breeding material for pest and disease resistance.

Keywords

Rice, Nagina 22, DUS characters, mutant lines.

Introduction

As the essential food, rice plays a prominent role in feeding more than 50% world`s population. It is cultivated over a hundred countries with a total paddy production of about 769.9 million tones all over the world (FAO, 2018). South Asia is one of the major centers for rice domestication and it has been chronicled as the “food basket” and “food bowl” of Asia. Among the entire Asian countries, India is the pronounced rice growing country computing for about 20% of all world rice production. Besides the conventional varieties, India is an inland to vast varieties of rice cultivars, landraces and many lesser known varieties that have been cultivated by farmers as well as local promoters. These landraces were refined through selection, depend on enticing characters such as grain yield, grain length, cooking quality, aroma and refitting to various abiotic stresses. Such process of selection eventuated in a broad scale of rice varieties adapted to a wide range of agro-ecological circumstances. That is why almost all the rice growing zones of India have their endemic regionally adapted cultivars suited for specific agro-climatic conditions as well as provincial preferences (Singh and Singh, 2003). Genetic and stratified information about the local varieties is the primary concern for germplasm conservation (Sinha and Mishra, 2012). Collection, preservation and characterization of such germplasm may provide great opportunity to utilize them in crop improvement. The selected genotypes with desirable traits provides a great scope to use them as non recurrent parent in back cross breeding programme to thrive and expand pest or disease resistance in the background of a high yielding variety. Genotypes characterized for distinctness, uniformity and stability, using DUS test guidelines could be secured as new variety under protection of plant varieties and farmers right (PPV and FR) act 2001. As the upland rice variety Nagina 22 possesses valuable traits such as drought tolerance, heat tolerance and resistance against pests and diseases, useful for climate resilient agriculture, induction of loss-of-function mutations affecting such traits and gain of function mutations in key developmental and agronomically important genes afford opportunities for identification and isolation of the underlying genetic factors (Mohapatra *et al.*, 2014). The mutant lines of Nagina22 which were developed from the Department of Rice, Tamil Nadu Agricultural University, Coimbatore, were not characterized morphologically for their uniqueness and stability earlier. Hence, the present study was intended at morphological characterization based on DUS test guidelines.

Materials and Methods

A set of five hundred and forty two mutant lines of Nagina 22 rice variety from M_4 generation were taken for the present study. Characterization of mutant lines was performed at Department of Rice, Tamil Nadu Agricultural University, Coimbatore, during *kharif* 2018 by following 8 x 8 simple lattice design with two replications. Observations were noted on the distinguishable characters given in the DUS test guidelines for paddy (Shobha Rani *et al*., 2004) and also on the characters *viz* ., yield and its component characters plant height, panicle length (PL), number of tillers (NOT), number of productive tillers (NPT), effective tillering percentage (ETP), number of grains per panicle (NOG), number of filled grains (NOFG), number of chaffy grains (NOCG), 1000-grain weight and single plant yield (SPY).

Morphological characterization was carried out at various physiological crop growth stages. Some of the specific traits such as colour of basal leaf sheath, auricle, leaf ligule, sterile lemma, awns, colour of stigma, spikelet tip colour of lemma and colour of awns were compared with Munshell leaf colour charts to differentiate the characters based on morphological evaluation. Grain length and width was measured by means of Graphical method. Pubescence on leaf blade and lemma were observed using magnifying lenses. Presence or absence of leaf auricles, awns and lodging incidence were recorded visually by observing individual plants. Angular characters such as shape of ligule, flag leaf attitude, flag leaf attitude of blade , curvature of main axis of the panicle and attitude of panicle branches were recorded by comparing with the photographs provided in guidelines for conduct of test for DUS on rice (SubbaRao *et al*., 2013). The lists of mutant lines of Nagina22 were ranged from MG-01 to MG-542 and these were taken under consideration for this study (Fig.1.)

Results and Discussion

According to DUS test guidelines, morphological and quantitative characters were furnished and depicted above. Out of 542 mutant lines, majority of the mutant lines had purple lines as basal leaf sheath colour (68.45%). When leaf - blade pubescence was considered, all the 542 mutant lines were found to be weak. Leaf Auricle was absent for all mutants. Nearly 97% of mutants were colourless with respect to leaf anthocyanin, while Umarani *et al.* (2017) revealed that 75.71% genotypes under their study was marked as colourless with respect to leaf anthocyanin. Colour of auricle was found to be light purple and purple which contributed 2.58% and 0.36% respectively. Almost all the mutant lines (99.36%) showed acute ligule leaf shape. Subbarao *et al*. (2013) had reported that all the genotypes under their study showed the same acute ligule leaf shape. White coloured leaf ligule was more prominent with 86.53% than light purple and purple coloured ligules which showed 13.09% and 0.36% respectively.

Blade attitude of flag Leaf was observed as erect and it was recorded in 65.31% of mutants, whereas semi erect in 31.18% and horizontal in 3.50% of mutants, while Kalyan *et al*. (2017) in their work showed 85.71% as erect and 14.29% as semi erect flag leaf`s blade attitude. The percentage of 9.77% mutant lines had no lemma - colouration and 12.73% had weak, 44.28% had medium and 33.21% had strong lemma colouration. About 365 mutant lines (67%) showed light purple coloured colour of stigma while white, yellow and purple contributes for 26%, 1% and 6% respectively. Likewise Umarani *et al.* (2017) also got variation in the distribution of colour of stigma. Very short plant height was observed for 44.28% (240 mutant lines) of the total mutants, 39.48% were under short plant height, 12.546% were under medium plant height, 3.136% were under long plant height and only 3 plants exhibited very long plant height of which 155.5cm was recorded as the highest plant height in mutant 494. Erect and semi erect flag leaf contributed nearly equal mutants (258 in erect and 259 in semi erect). While 22 lines showed horizontal and 3 lines showed dropping flag leaf. For panicle curvature, 227 lines showed deflexed, 146 showed semi straight, 138 showed dropping and 31 had straight. Kalyan *et al*. (2017) depicted in their work that 20 out of 35 cultivars (57.14%) showed deflexed and 10 showed dropping panicle curvature. About 322 and 188 lines have recorded 59.409% and 34.686% for yellowish white and brown coloured spikelet tip colour of lemma respectively, adjacently others contributes only for 5.905%.

Awns were present in 398 lines and absent in 144 mutant lines. Manjunatha *et al*. (2018) also reported the absence of awns (90%) in their DUS characterization of genotypes. Majority of the mutants (90.03%) showed colour of awns as yellowish white while others (yellowish brown,

brown, reddish brown, light red, red, light purple, black and purple) contributed for only 9.97%. About 226 mutants exhibited for the trait panicle distribution of awns at tip only, whereas 205 lines exhibited in upper half only, 111 lines exhibited in whole length. Chakravorty and Ghosh (2012) study revealed that 92.15% of the genotypes under consideration had panicle distribution of awns at tip only. Erect to semi erect panicle attitude of branching was noticed in 303 lines whereas erect in 36 lines, semi erect in 102 lines, semi erect spreading in 76 lines and spreading in 25 lines. Similar kind of distribution in panicle attitude of branching was observed with 26.67% showed semi erect to spreading and 53% showed spreading panicle attitude of branching (Manjunatha *et al* ., 2018). Panicle exertion was partly in 41.512%, mostly exerted in 43.17% and well exerted in 15.513%. Indeed 92.80% of sterile lemma colour was straw coloured and 7.2% was golden. Vegetative vigor was normal in 482 plants (88.92%), vigorous in 56 plants (10.332%), and weak in only 4 plants. Half of the mutants had medium tillering ability while very high was found in 135 and good in 134 plants. No lodging incidence was observed in 529 plants. More than half of the total mutants (294 lines which is 54.24%) has short panicle length. Yan *et al.* (2007) also observed polymorphism for the traits plant height, awn type, panicle type, colour of lemma and palea and pubescence of lemma based on 1,790 entries sampled from 114 countries. Totally 476 mutants showed very short grain length and 65 showed short grain length. Grain width was very narrow for 209 mutants, narrow for 301 mutants, medium for 28 mutants and broad for the remaining 3 mutants. For 1000 grain weight, 57.93 % of mutants had low state.

Characterization of mutants of M4 generation to assess their distinctness had recorded the existence of distinctness, uniqueness and stability among the mutant lines. From the event of the study, it is be evident that characterization has habituated the presence of distinctness, uniqueness and stability for the traits considered as given in the guidelines. The mean values of check variety (N22) compared with the mutant population and the results had indicated the superiority of yield related characters over the check variety which is depicted in Table 1. Out of 542 mutants, 52 mutants performed better than Nagina 22 check in important yield traits *viz*., panicle length, number of tillers, number of productive tillers, number of grains per plant,1000-grain weight and also the grain yield per plant. Athira *et al.* (2018) had similar and superior results in the yield traits of Nagina 22 mutants over the Nagina 22. Based on this research, highly distinguished rice genotypes would be opt for forwarding to further generation and registration as farmers variety. And these genotypes can also be used in crop improvement event in terms of both quality traits and high yield even as source or breeding material for pest and disease resistance.

References

Athira, S., Bhagya, V., Subashini, G., Muthuvijayaragavan, R., Rajeshwari, S., Manonmani, S., and Robin, S. (2018). Research Article Exploitation of induced variation for enhancing the biomass production in rice (*Oryza sativa L.). Electronic Journal of Plant Breeding*., **9**(4), 1512-1520.

Chakravorty, A., and Ghosh, P. D. (2012). Characterization of Landraces of rice following DUS guidelines. *Research in Plant Biology.,* **2**(6).

FAO. (2018, April). Rice Market Monitor., (Vol. **21**, pp. 1-25).

Kalyan, B., Radha Krishna, K. V., and Subba Rao, L. V. (2017). DUS characterization for germplasm of rice. *International Journal of Current Microbiology and Applied Sciences.*,**6**(10), 3480-3487.

Manjunatha, G. A., Elsy, C. R., Rajendran, P., Joseph, J., Francies, R. M., and Krishnan, S. (2018). Research Article DUS Characterization of rice (*Oryza sativa L.*) landraces of wayanad, kerala. *Electronic Journal of Plant Breeding.,* **9**(2), 617-630.

Mohapatra, T., Robin, S., Sarla, N., Sheshashayee, M., Singh, A. K., Singh, K. and Sharma, R. P. (2014, March). EMS induced mutants of upland rice variety Nagina22: generation and characterization. *Proceedings of the Indian National Science Academy.,* **80(**1): 163-172.

Shobha Rani, N., Shobha Rao, L. V., Viraktamath, B. C., and Mishra, B. (2004). *National guidelines for the conduct of tests for distinctiveness, uniformity and stability*. Directorate of Rice Research, 6-13.

Sinha, A. K., and Mishra, P. K. (2012). Agronomic evaluation of landraces of rice *(Oryza sativa*) of Bankura district of West Bengal. *Columban Journal of Life Science,* **13**(1and2), 35-38.

Singh, R. K., Singh, U.S. (2003*) A Treatise on Scented Rices of India*. Kalyani Publishers, New Delhi.

Subba Rao, L. V., Shiva Prasad, G., Chiranjivi, M., Chaitanya, U., and Surendhar, R. (2013). DUS characterization for farmer varieties of rice.

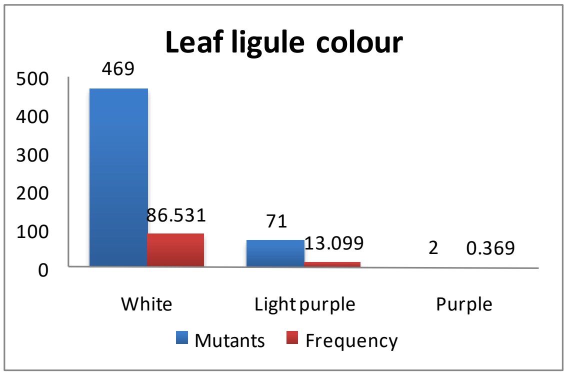
IOSR Jouranl of Agricultural Veterinary Science., **4**(5), 35-43

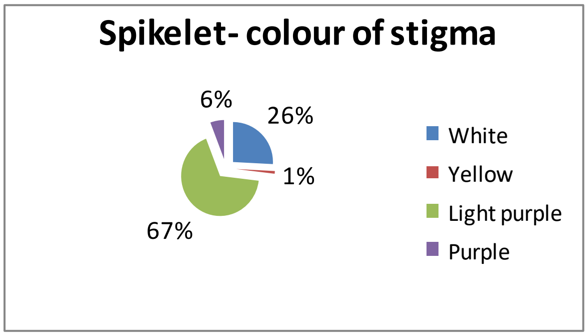
Umarani, E., Radhika, K., Padma, V., and Rao, S. L. V. (2017). Agro-morphological characterization of rice (Oryza sativa L.) landraces based on DUS descriptors. *International Journal of Pure Applied Bioscience.,* **5**, 466-475.

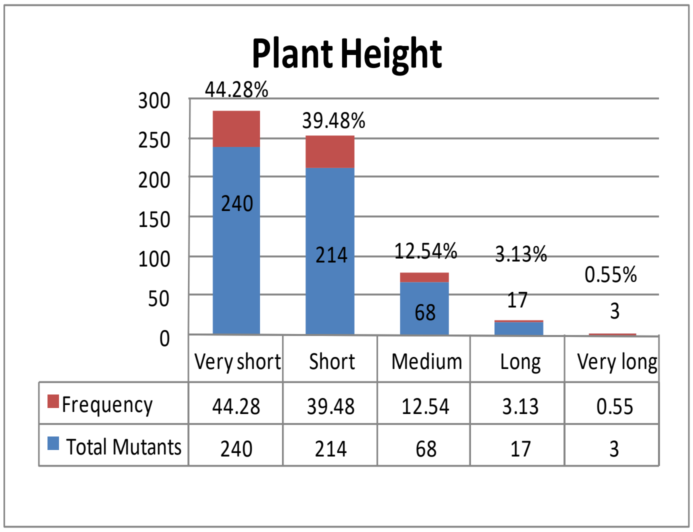
Yan, W., Rutger, J. N., Bryant, R. J., Bockelman, H. E., Fjellstrom, R. G., Chen, M. H., and McClung, A. M. (2007). Development and evaluation of a core subset of the USDA rice germplasm collection. *Crop Science.,* **47**(2), 869-87

Table 1. Mean values of yield and its component characters of the mutant lines superior to check variety N22

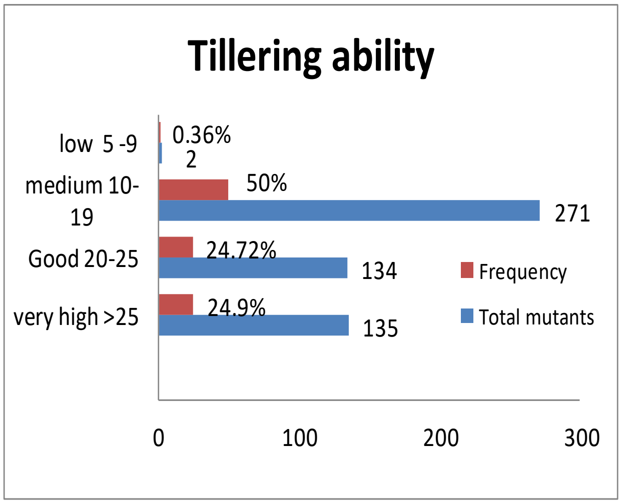
M.No	PL	NOT	NPT	ETP	NOFG	NOCG	NOG	1000GW	SPY
N22	**18.72**	**25.2**	**17.25**	**68.45**	**59**	**13**	**72**	**18.5**	**22.38**
31	19.1	26	18	69.23	136	50	186	19.48	47.69
32	28.8	43	32	74.42	75	76	151	24.36	58.47
40	21.5	33	25	75.76	82	8	90	25.62	52.53
46	25	45	35	77.78	82	50	132	18.63	53.47
76	23.5	48	35	72.92	63	12	75	20.71	45.66
95	21	42	30	71.43	75	11	86	22.17	49.87
161	19.3	33	26	78.79	70	41	111	25.37	46.17
178	21.7	43	33	76.74	92	18	110	19.56	59.39
180	20.5	44	37	84.09	67	35	102	21.57	53.47
185	24.9	28	21	75	111	30	141	19.37	45.15
197	22.4	48	41	85.42	74	9	83	19.19	58.23
201	23.5	29	21	72.41	76	10	86	19.95	31.84
229	23.5	32	25	78.13	77	41	118	18.89	36.37
232	22.4	38	31	81.58	84	6	90	22.57	58.77
236	20	45	37	82.22	71	5	76	19.65	51.63
238	21	27	20	74.07	63	7	70	19.99	25.19
246	22	26	18	69.23	85	13	98	20.62	31.55
248	18.9	38	30	78.95	85	4	89	19.48	49.68
254	21.87	29	21	72.41	103	5	108	23.02	49.8
266	20.6	36	29	80.56	90	5	95	18.65	48.69
268	20.5	36	29	80.56	70	17	87	26	52.77
269	20	40	34	85	82	15	97	21.06	58.71
274	20	40	31	77.5	80	9	89	19.03	47.19
275	19.5	28	19	67.86	65	7	72	19.57	24.17
276	25.4	33	26	78.79	110	14	124	20.96	59.96
277	25.6	36	28	77.78	76	3	79	28.02	59.64
295	23	26	18	69.23	84	18	102	23.82	36.01
311	24.8	27	19	70.37	142	18	160	21.83	58.89
314	20	26	18	69.23	75	11	86	22.11	29.85
315	21	29	21	72.41	78	11	89	19.69	32.26
353	20.4	29	20	68.97	112	44	156	21.6	48.38
360	22	54	46	85.19	60	9	69	19.02	52.48
381	22.5	38	29	77.19	86	6	92	20.61	52
390	23	33	24	72.73	116	57	173	21.24	59.12
397	26.2	28	20	70.24	159	107	266	18.73	58.57
398	21.5	27	19	69.14	146	54	200	19.88	54.18
433	22	28	21	75	87	20	107	20.36	37.19
437	33.3	28	19	69.05	113	71	184	22.57	49.31
438	24.3	30	23	76.67	101	21	122	25.66	59.6
439	26.3	26	19	71.79	68	7	75	21.11	26.8
450	25.4	30	23	76.67	74	17	91	22.59	38.44
353	20.4	29	20	68.97	112	44	156	21.6	48.38
360	22	54	46	85.19	60	9	69	19.02	52.48
381	22.5	38	29	77.19	86	6	92	20.61	52
390	23	33	24	72.73	116	57	173	21.24	59.12
397	26.2	28	20	70.24	159	107	266	18.73	58.57
398	21.5	27	19	69.14	146	54	200	19.88	54.18
433	22	28	21	75	87	20	107	20.36	37.19
437	33.3	28	19	69.05	113	71	184	22.57	49.31
438	24.3	30	23	76.67	101	21	122	25.66	59.6
439	26.3	26	19	71.79	68	7	75	21.11	26.8
450	25.4	30	23	76.67	74	17	91	22.59	38.44

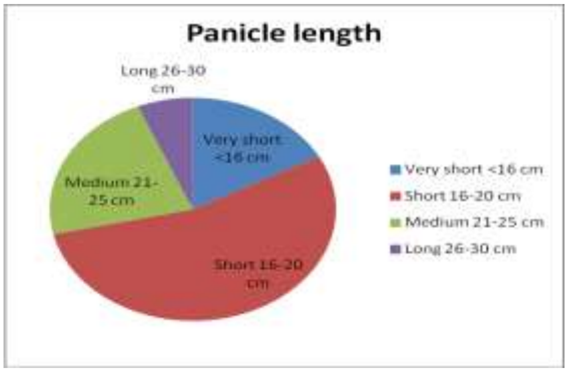


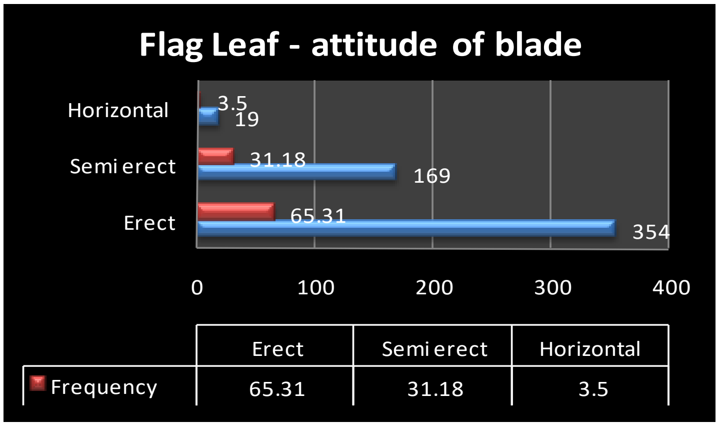




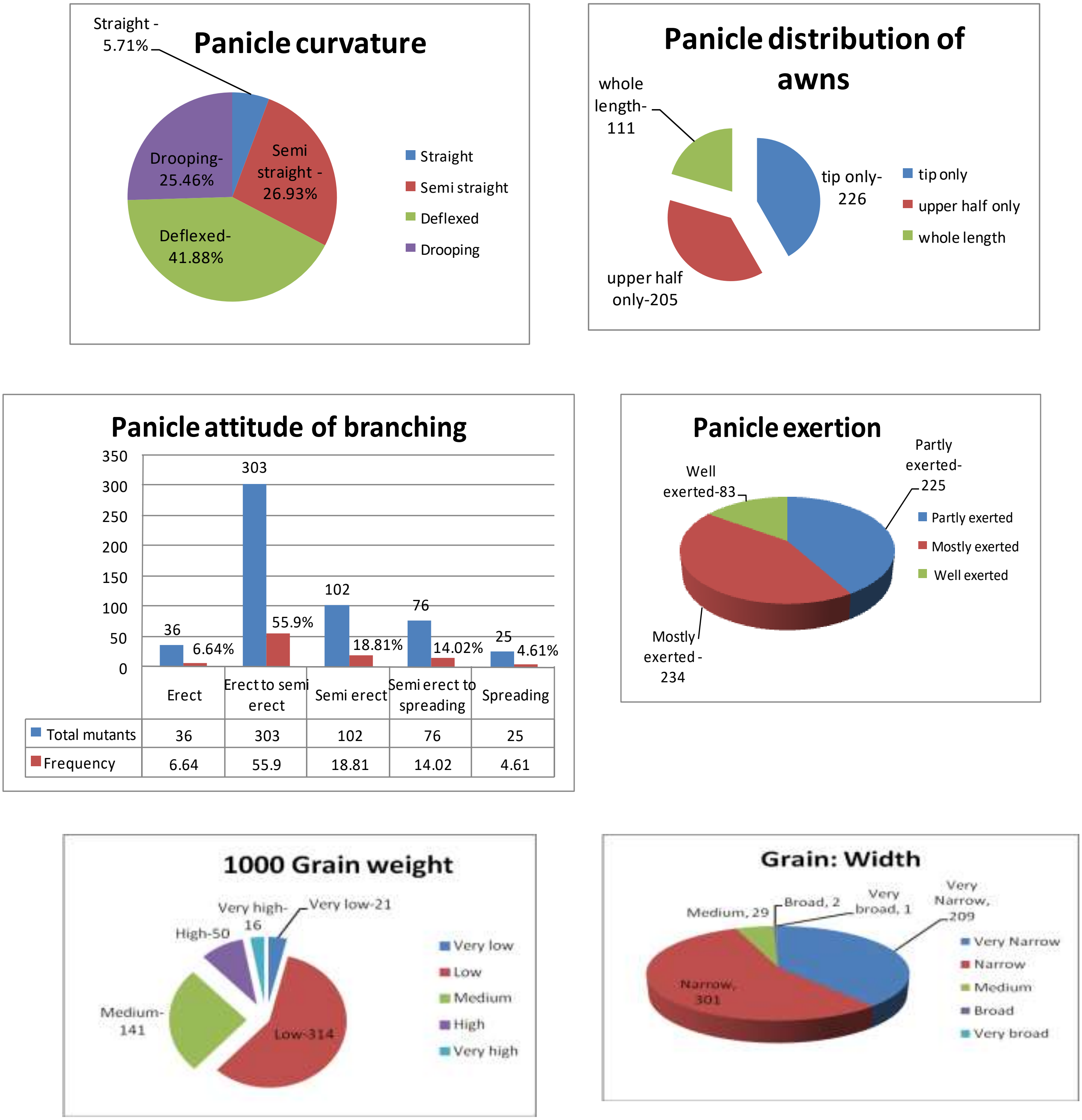
	Very short	Short	Medium	Long	Very long
Frequency	44.28	39.48	12.54	3.13	0.55
Total Mutants	240	214	68	17	3







	Erect	Semi erect	Horizontal
Frequency	65.31	31.18	3.5



	Erect	Erect to semi erect	Semi erect	Semi erect to spreading	Spreading
Total mutants	36	303	102	76	25
Frequency	6.64	55.9	18.81	14.02	4.61

Fig. 1. Characterization of rice mutants based on DUS guidelines

https://ejplantbreeding.org