Evaluation of Indigenous Landraces of Ricebean (*Vigna umbellata*) from Nagaland for Growth and Yield Attributing Characters

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Thirty landraces of ricebean collected from different localities of Nagaland were field evaluated for growth, development and yield attributing characteristics. The landraces exhibited significant variations particularly for yield attributing characteristics like 100 seed weight, number of pods per plant, number of seed per pod and pod length. The 100 seed weight character had highest heritability (0.984) followed by number of seeds per pod and number of pods per plant. The 100 seed weight also had maximum direct effect on yield (0.683) followed by seed per pod, pod length and pods per plant.

Key words: Ricebean, *Vigna umbellata*, Non conventional pulse, Yield attributing characters, Variability

Pulse grains and other leguminous plants are among the best sources of plant protein and were used as integral part of diet in India since time immemorial where majority of the population are vegetarian. In recent times emphasis on non-conventional pulses or legumes are gaining momentum due to perpetual stagnation in pulse production and growing demand for pulses. Non-conventional pulses can be defined as those legumes which are semi-wild or under-utilised or cultivated as backyard crop or in small areas in isolated and have great potentiality as a crop. With 35% of world area under pulse cultivation and 27% of world production; India is the world's leading producer of pulses but still India is the largest importer of pulses (Ashthana, 2000). Conventional pulses are basically recalcitrant crop, not amenable to genetic improvement and hence unlike cereals, pulses have very limited number of genotypes, cultivation of pulses are confined to northern India, which accounts for 78 per cent of country's pulse production, due to specific agro-climatic requirement and most experts are of the opinion that further expansion of pulse growing area is not possible (Ashthana, 2000). Pulse productivity is one area where green revolution did not have much impact. During pre-green revolution period pulse production in India varied from 10-11 million tons/year with a maximum of 15mt/year in 1958, which is comparable to post-green revolution period (Gadgil *et al.*, 1999). Against this stagnation in pulse production India's population has jumped from 36.1 crores in 1951 to 100 crores in 2001. As a consequence per capita availability of pulse dropped from 27 kg/year in 1958 to 13 kg/year in 1995. Considering the futuristic requirement it is estimated that India's pulse requirement will be 23 mt per year in 2020 AD (Kumar, 2000) which appears to be extremely difficult target, because India's pulse production never exceeded 14 mt/year in the last half century.

Against this alarming scenario of pulse productivity and pulse demand, a promising option is to evaluate the legume biodiversity, short listing the little-known but promising seed legumes and bringing the areas not covered by conventional pulses, under non-conventional pulses. North-Eastern and India is not a traditional pulse growing area because of its unsuitable climatic condition for cultivation of major pulses. But it is very rich in legume biodiversity. Among the North-Eastern states Arunachal Pradesh is richest in legume biodiversity (with 67 genera and 195 species) followed by Assam (with 68 genera and 171 species (Mao and Hynniewta, 2000). Among the non-conventional pulses, the most promising one is *Vigna umbellata* (Thunb.) Ohwi and Ohashi popularly known as ricebean. Unlike the conventional pulses in ricebean appreciably high genetic variation exist in rice bean and they can be grown in a wide range of agro-climatic conditions. Moreover, ricebean is generally resistant to most of the common leguminous diseases and pests (Chandel *et al,* 1980). In Nagaland, various ethnic tribes have been cultivating ricebean since time immemorial. However there is little or no record about the scientific scrutiny of the land races of ricebean from Nagaland. The present study was intended to collect and make preliminary evaluation of the landraces of ricebean from Nagaland.

Materials and Methods

Under field condition of Nagaland ricebean matures and becomes ready for harvest in November. Seed collection was done during the period of November

to February through visits to various villages of Nagaland. The sites of collection in Nagaland were shown in figure 1. The individual landraces were demarcated on the basis of seed size and seed colour. A total of 30 genotypes were collected and studied through field trial. Field trials were carried out in the experimental farm of the School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema (altitude 305 m), Nagaland during 1998 and 1999. The climate is sub-tropical, predominantly humid with moderate temperature and medium to high rainfall. Field experiment was conducted in a randomised block design with three replications. Separate bamboo poles were provided to individual plants to ensure that they do not intermix. Seed sowing was done in the middle of June and observations were recorded on five plants selected randomly for each landrace in each replication. At maturity these plants were harvested and thrashed separately and data were recorded for the following - shoot length of the seedling, number of branches per plant, days to 50% flowering, days to maturity, number of pods per peduncle, number of pods per plant, number of seeds per pod, 100 seed weight. Analysis of variance was carried out as per the method outlined by Panse and Sukhatme (1978). Phenotypic and genotypic coefficients were calculated according to the formulation of Burton and Devane (1953). Phenotypic and genotypic correlation coefficient were worked out to study the inter-relationship between various pairs of characters as suggested by Al-Jibouri *et al,* (1958). Path coefficient analysis was carried out following the method of Dewey and Lu (1959).

Results and Discussion

Wide variations were observed for plant height 30 days after sowing. Highest growth rate in the range of 29.15 and 35.23 cm were recorded for a total of 13 cultivars, while lowest growth rate in the range of 19.83 to 23.0 cm were recorded for only 3 cultivars. As a whole mean growth rate was 28.22 cm with 18.51 per cent coefficient of variation. However, the number of primary branches exhibited limited variation in the range of 5.02 to 8.78 with a mean value of 7.05 and 16.34 per cent coefficient of variation. Considerable variations were observed in case of days to 50 per cent flowering. Twelve cultivars exhibited 50 per cent flowering in the time range of 99.0 to 109.75 days and these cultivars can be categorised as early flowering group. The remaining 18 cultivars took 110.8 to 122.0 days for 50 per cent flowering

Table 1. Growth and development data for plant height 30 days after sowing, primary branches per plant/days to 50 per cent flowering and days to maturity

Cultivar	Height at 30 (crn)	Primary branches per plant	Days to 50% flowering	Days to maturity
RB-1	26.87	8.26	108.30	145.92
RB-2	23.00	6.49	117.50	143.50
RB-3	28.26	7.54	110.80	146.95
RB-4	28.56	6.08	119.40	151.85
RB-5	19.83	8.04	119.40	146.10
RB-6	26.94	5.94	105.50	145.00
RB-7	35.23	7.53	113.00	147.50
RB-8	33.90	7.26	122.00	146.80
RB-9	26.31	5.02	112.50	146.50
RB-10	28.56	5.69	110.40	146.50
RB-11	29.27	8.78	112.50	146.50
RB-12	26.17	5.69	109.60	145.00
RB-13	29.94	6.77	99.00	144.50
RB-14	29.15	7.03	111.25	146.60
RB-15	31.75	6.54	108.70	146.75
RB-16	30.98	6.61	106.70	147.30
RB-17	29.84	7.08	107.00	146.50
RB-18	31.41	7.88	109.75	143.85
RB-19	25.53	8.39	111.00	149.50
RB-20	31.06	7.63	110.50	145.50
RB-21	27.77	6.40	112.70	150.18
RB-22	27.21	6.07	118.00	146.50
RB-23	25.17	6.36	116.35	146.75
RB-24	32.22	6.66	106.60	147.60
RB-25	26.64	7.82	110.10	146.00
RB-26	25.74	6.28	105.10	147.00
RB-27	28.33	8.43	108.40	147.31
RB-28	20.60	7 71	108.50	146.25
RB-29	30.56	8.60	112.60	146.00
RB-30	30.12	6.28	120.20	152.65

The values are mean for two successive years

Table 2. Data for yield attributing characters viz. pod per peduncle, pod length, pod per plant, seed per pod, 100 seed weight and grain yield per plant

Cultivar	Pod per Peduncle	Pod length	Pod/ plant	Seed/ pod	100 seed weight (gm)	Grain / plant(gm)
RB-1	2.41	8.64	44.72	3.87	8.29	20.18
RB-2	1.37	11.55	36.43	5.00	23.17	46.37
RB-3	1.77	9.99	30.42	4.25	19.81	35.98
RB-4	2.22	10.03	61.33	7.32	25.23	55.68
RB-5	1.10	7.24	68.28	5.17	9.15	36.97
RB-6	1.27	8.33	36.08	5.37	8.68	22.68
RB-7	1.79	9.00	35.97	6.98	13.23	30.26
RB-8	1.98	11.30	57.43	6.71	19.52	61.35
RB-9	1.35	8.46	36.37	5.39	19.38	37.35
RB-10	1.18	8.56	30.72	4.28	11.87	21.68
RB-11	1.40	8.81	29.45	4.58	11.82	22.10
RB- 12	1.33	9.21	38.61	5.35	13.73	30.93
RB-13	1.59	8.73	56.45	6.35	19.44	62.22
RB-14	2.28	9.57	48.44	4.47	14.45	32.72
RB-15	1.29	10.04	55.70	4.07	14.18	31.74
RB-16	1.14	8.48	46.78	4.49	12.26	30.96
RB-17	1.43	9.21	36.45	4.68	12.38	27.40
RB-18	1.32	9.07	52.48	6.98	19.04	54.64
RB-19	1.28	8.35	43.94	4.19	18.33	34.46
RB-20	2.28	8.56	40.71	4.69	19.83	32.40
RB-21	2.42	9.36	62.09	5.50	20.98	58.81
RB-22	1.96	7.70	32.54	4.35	20.76	22.46
RB-23	1.43	8.02	38.00	6.42	8.08	28.75
RB-24	1.59	9.65	55.31	4.44	25.98	61.68
RB-25	1.74	7.60	30.24	5.19	7.58	19.48
RB-26	1.59	7.78	35.34	5.44	7.24	23.00
RB-27	1.83	8.45	62.77	5.96	12.07	53.34
RB-28	2.19	7.84	58.66	5.55	7.38	34.12
RB-29	2.27	9.60	52.82	6.92	12.67	43.68
RB-30	1.20	9.10	58.28	4.70	18.17	40.46

The values are mean for two successive years

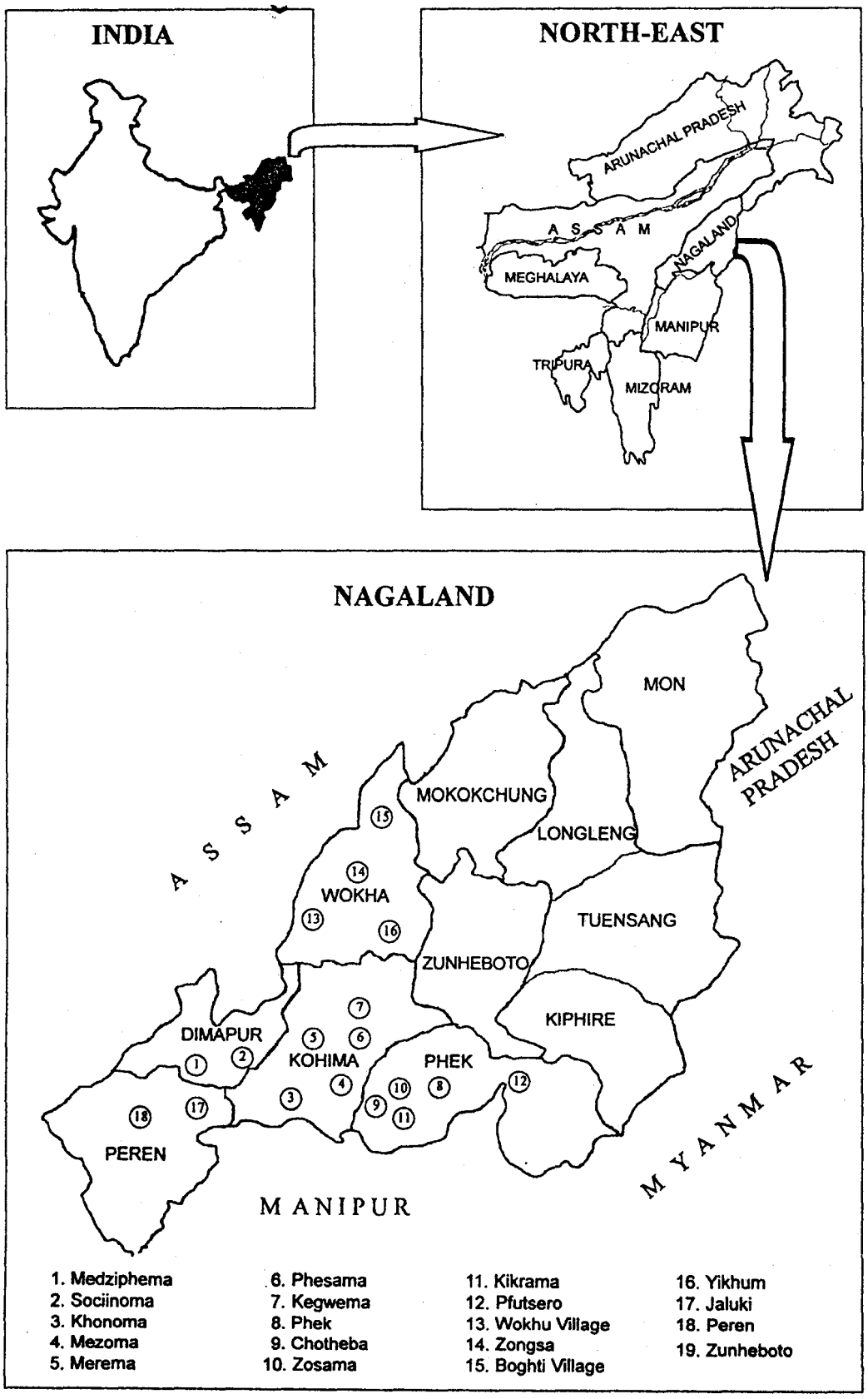

Fig. 1: *Localities of Nagaland from where indignous land races of ricebean were collected*

and can be considered as late flowering group. Time to maturity exhibited little variation as evident from the fact that coefficient of variation was 2.36 per cent with the range of variation being 143.5 to 152.65 days. Majority of the cultivars numbering 26, amounting to 86.6 per cent of all cultivars under study required 143.5 to 147.65 days for maturity.

Among the yield attributing characters number of pods per peduncle exhibited least variation which were in the range of 1.10 to 2.42 with a coefficient of variation 3.28 per cent and mean value of 1.59. On the other hand pod length exhibited considerable variation; the range being 7.24 to 11.55 cm with 14.67 per cent coefficient of variation. Half of the total cultivars had pod length in the range of 8.73 to 11.55 cm. Extensive variation was observed for pod per plant which is a foremost yield attributing character. The coefficient of variation was 59.77 per cent and the range of variation being 29.45 to 68-28 pods per plant. However half of the total cultivars had 29.45 to 44.72 pods per plant and only 8 cultivars had 56.45 to 68.28 pods per plant. Number of seeds per pod exhibited good deal of variation as evident from the fact that range of variation was 3.87 to 7.32 seeds per pod with 17.88 per cent coefficient of variation. Ten cultivars belonged to the group with relatively higher number of seeds per plant in the range of 5.50 to 7.32.

Of all the traits in the present study 100 seed weight exhibited very wide range of variation which was in the range of 7.24 to 25.98 gm with 38.18 per cent coefficient of variation. Cultivars RB-26 and RB-24 had 7.24 and 25.98 g weight for 100 seeds representing lowest and highest value implying that biggest seeds were 3.6 times bigger than the smallest seeds. Thirteen cultivars were characterised by relatively bigger seeds in the size range of 18.33 – 25.98 g/per 100 seed. Like 100 seed weight, grain yield per plant exhibited extensive variation which is evident from the fact that the range of variation was 19.48 to 62.22 g per plant and coefficient of variation was 62.78 per cent. RB-25 and RB-13 had 19.48 and 62.22 g grain yield per plant representing the lowest and highest value. Thus cultivar with highest yield per plant had 3.2 times more productivity than the cultivar with lowest yield which reflect the high degree of variability with respect to yield per plant. The range, mean, SE and coefficient of variation are shown in Table 3. Heritability estimate reveals that 100 seed weight had highest heritability (0.984) followed by number of seed per pod and number of pods per plant (Table 4). Genotypic and phenotypic path for different characters are shown in Table 5 and Table 6. The 100 seed weight contributed maximum direct effect on yield (0.683). Number of seeds per pod, pod length and number of pods per plant also contributed significantly to yield. Genotypic and phenotypic correlation for different character combination are shown in Table 7 and Table 8. Singh *et al.* (1998) evaluated 100 cultivars of ricebean collected from different ecogeographic origin for growth and yield attributing characteristics. The study revealed significant variability among the cultivars, particularly for yield attributing characters which is in conformity with the present study. Therefore unlike conventional pulses ricebean exhibited wide variability and can be exploited for breeding programmes. Although both the species have 2n = 22 (Kaur and Satij, 1988) interspecific hybridization between *V. umbellata* and *V. radiata* is not possible. Because of such limitations in interspecific hybridisation, the intraspecific variations observed in *V. umbellata* hold great promise for genetic improvement through hybridization.

Table 3. Range, mean, standard error (SE) and coefficient of variation (CV) for different characters of ricebean

Characters	Range	Mean	SE	CV (%)
Plant height at 30 days after sowing (cm)	19.83-35.23	28.22	0.48	18.51
Primary branches/plant	5.62-8.78	7.05	0.13	16.34
Days to 50% flowering	99.00-22.00	110.40	0.63	5.50
Days to maturity	143.50-152.65	146.37	0.36	2.36
Number of pods /peduncle	1.10-2.42	1.59	0.06	32.84
Pod length (cm)	7.24-11.55	8.97	0.14	14.67
Number of pods/plant	29.45-68.28	44.91	2.77	59.77
Number of seeds/pod	3.87-7.32	5.28	0.10	17.88
100 seed weight (gm)	7.25-25.98	15.47	0.61	38.18
Grain yield/plant	19.48-62.22	37.12	2.89	62.78

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Table 4. Estimate of genotypic and phenotypic variability, heritability, genetic advance, genetic advance as per cent of mean and genotypic and phenotypic coefficient of variability

Character	Genolypic Variability (GV)	Phenotypic variability (PV)	Heritability (h^2)	Genetic-Advance (GA)	Genetic Advance % of mean	Genotypic coefficient of variability (GCV)	Phenotypic coefficient of variability (PCV)
Plant height at 30 days of sowing (cm)	2.313	21.291	0.109	1.031	3.642	5.372	6.299
Primary branches per plant	0.550	1.719	0.319	0.857	12.156	10.519	18.598
Days to 50 % flowering	25.676	36.339	0.707	8.736	7.913	4.589	5.459
Days to maturity	7.129	11.338	0.629	4.342	2.966	1.824	2.301
Numbers pods per peduncle	0.112	0.292	0.384	0.425	25.086	19.754	31.895
Pod length in cm	0.570	1.158	0.492	1.085	12.115	8.430	12.016
Number of pod per plant	150.278	203.212	0.739	21.595	48.086	27.297	31.742
Number of seeds per pod	0.691	0.852	0.811	1.535	29.044	15.728	17.465
100 seed weight (gm)	34.627	35.207	0.984	11.969	74.541	37.503	37.816
Grain yield per plant	352.619	729.839	0.483	26.749	72.941	51.206	73.668

Table 5. Genotypic correlation for different character combination

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	x_{10}
X_1	**0.0635**	–0.3793	0.1797	–0.1842	0.7623	0.9984	–0.1089	0.5766	0.9946	0.9165
X_2		**1.2039**	1.04X2	0.5902	0.7569	1.8053	–0.3179	1.7730	–0.5672	0.1207
X_3			**–0.2128**	–0.6434	0.8891	0.0515	1.1817	0.0839	–0.0400	0.4790
X_4				**0.4958**	–0.3267	0.2685	–0.2862	0.2739	0.2788	0.00254
X_5					**–0.2933**	0.0689	–1.0825	0.0207	0.0810	–0.5258
X_6						**–0.1299**	0.6284	0.1484	0.00119	0.3162
X_7							**–0.1122**	–0.0679	0.3942	0.2166
X_8								**0.1219**	0.0271	0.5986
X_9									**0.0866**	0.5484
X_{10}										**0.6966**

Table 6. Phenotypic correlation for different character combination

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	x_{10}
X_1	**–0.0400**	0.1089	0.0333	–0.0266	0.05338	0.1495	0.2089	0.1999	0.3404	0.2971
X_2		**0.0110**	0.1547	0.0245	–0.0825	0.0597	–0.1204	0.1401	–0.0421	0.1171
X_3			**–0.0209**	–0.2520	0.0808	0.00254	0.3924	–0.0242	–0.0232	0.1610
X_4				**0.3569**	–0.1466	0.1186	–0.5106	0.2012	0.2449	0.0916
X_5					**–0.1887**	0.0641	–0.6378	0.0822	0.0470	–0.2027
X_6						**0.0251**	0.3745	0.10808	0.0170	0.1889
x_7							**0.0397**	0.0986	0.2592	0.1824
X_8								**0.0914**	0.000109	1.3396
X_9									**0.0866**	0.3753
X_{10}										**0.4677**

Table 7. Genotypic path for the different characters of ricebean in the present study

	1	2	3	4	5	6	7	8	9	10
1	0.007	0.000	–0.041	–0.037	0.029	–0.079	0.062	–0.0302	0.302	0.679
2	0.001	0.000	–0.043	–0.216	–0.095	–0.078	0.112	–0.099	0.927	–0.388
3	–0.003	0.000	0.036	0.044	0. 1 03	–0.092	0.003	0.370	0.044	–0.027
4	0.001	0.000	–0.008	–0.206	–0.079	0.034	0.017	–0.090	0.143	0.191
5	–0.001	0.000	–0.023	–0.102	–0.161	0.030	0.004	–0.340	0.011	0.055
6	0.006	0.000	0.032	0.067	0.047	–0.103	–0.008	0.197	0.078	0.001
7	0.007	0.000	0.002	–0.055	–0.011	0.013	0.062	–0.035	–0.035	0.269
8	–0.001	0.000	0.043	0.059	0.174	–0.065	–0.007	0.313	0.064	0.019
9	0.004	0.000	0.003	–0.056	–0.003	–0.015	–0.004	0.038	0.523	0.059
10	0.007	0.000	–0.001	–0.057	–0.013	–0.0001	0.024	0.008	0.045	0.683

Table 8. Phenotypic path for the different characters of ricebean in the present study

	1	2	3	4	5	6	7	8	9	10
1	–4.918	–0.001	1.419	–0.529	–0.143	–0.074	–0.082	–3.528	6.867	1.285
2	–0.211	–0.019	0.143	–2.456	–0.132	–0.114	–0.033	–2.033	4.813	0.159
3	–0.536	–0.001	13.029	–3.318	–1.356	–0.112	–0.001	–6.627	0.831	–0.088
4	–0.164	*–0.01)3*	–0.272	–15.874	–0.192	0.202	–0.065	8.623	6.912	0.925
5	0.131	–0.001	–3.283	–5.666	–5.382	0.260	–0.035	10.771	2.824	0.178
6	–0.265	0.002	1.053	2.327	1.016	–1.379	–0.014	–6.325	3.710	0.064
7	–0.735	–0.001	0.033	–1.883	–0.345	–0.035	–0.547	–0.670	3.387	0.978
8	–1.027	5.113	5.113	8.105	3.433	–0.517	–0.028	–16.888	3.139	0.001
9	–0.983	–0.315	–0.315	–3.194	–0.442	–0.149	–0.054	–1.544	34.353	0.327
10	–1.674	–0.302	–0.302	–3.888	–0.253	–0.024	–0.142	–0.002	2.975	3.776

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