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Utilization of principal component analysis in determining selection criteria and selection of superior and diverse inbred lines in maize (*Zea mays* L.)

SK Sinha, Rahul Singh, Jitendra Tiwari and Dinesh Thakur

Abstract
The present investigation was conducted with one ninety six maize (*Zea mays* L.) genotypes to evaluate their performance for principal component analysis in randomized block design with two replications. Total 14 PC groups were formed and out of these, only four principal components (PCs) exhibited more than 1.0 Eigen value and showed about 76.11% variability among the traits studied. The PC1 had 33.42%, PC2 showed 19.05%, PC3 exhibited 16.49% and PC4 showed 7.15% variability for traits under study. PC scores revealed that genotype TNAU/CBE-98, CAL 14114, IAMI-73, CAL 1462, CAL 14111 and Z490-23 in PC1 indicated that they had highly and positively associated for the characters contributed for yield traits viz., days to 80% maturity, final plant stand, plant height, ear height, ear length, ear girth, number of cobs per plot, number of kernels per row, test weight and grain yield kg per plot. The highest PC score of IAMI-44 followed by BLD 7, PFSR R5, Pharas gaon I-4, Jagdalpur I-2, IAMI-7, SC-104(2011), IAMI-33, PC-106 and Pharas gaon I-1 in PC2 exhibited for characters number of kernels per row and shelling percentage. Highest PC scores was obtained by IAMI-40, IAMI-29, IAMI-17, CML289-B-B-B, IAMI-22, IAMI-55, IAMI-35, VL121230, TNAU/CBE-98 and Pharas gaon I-I for characters like, days to 50% tasseling, days to 50% silking and ear length. PC scores in PC4 were recorded highest for characters plant height and ear height in genotypes DMR 10 RYFWS 8384 (B), SC-24-9(C12)-3-2-1-1, CM 104, IAMI-87, Jagdalpur I-2, IAMI-74, IAHM 2015-45, EC-611064, Z489-92 and Pharas gaon II-I. Among these the genotypes CAL 14114, IAMI-73, CAL 1462, Z490-23, TNAU/CBE-98, IAMI-44, BLD 7, PFSR R5, Jagdalpur I-2, IAMI-7, IAMI-33, PC-106, IAMI-40, IAMI-29, IAMI-17, IAMI-22, IAMI-55, IAMI-35, VL121230, EC-611064 and Z489-92 were identified as diverse lines.

Keywords: PCA, Variability, PC score, diverse

Introduction
Maize (*Zea Mays* L.) belongs to family graminae (2n=2x=20) and is an important staple food of many countries, particularly in the tropics and subtropics. This cereal is referred as Miracle crop and Queen of the Cereals due to its high productivity potential compared to other poaceae family members. It is a cereal with a remarkable potential for production, it is the third most important grain crop after wheat and rice. It is a cereal with a remarkable potential for production, it is the third most important grain crop after wheat and rice. Maize (*Zea mays* L.) is an exciting and leading crop contributing significantly to world agriculture and more importantly to world's food basket of roughly 2000 million metric tons (Vasal, S.K., 2014). It contributes maximum among the food cereal crops i.e. 38% annually in the global food production as compared to 30% for wheat and 20% for rice. In India, presently it occupies about 8.69 million hectares area with the mean yield of 2.53 tons/hectare (ICAR-IIMR, 2016). The availability of genetic variability is the basic pre-requisite for genetic improvement through systematic breeding programme. In crop plant, collection of germplasms and assessment of genetic variability is basic step in any crop improvement programme, which acts as a building block for generation of genetic variability. Evaluation and cataloguing of this variability is of paramount importance of its efficient utilization. Many modern cultivars in maize and in other crops as well, are often genetically similar, with a rather narrow genetic base. Therefore, in breeding we need to also utilize sources of new diversity. Knowledge on genetic divergence is very important in the selection of parents in hybridization programme for identifying heterotic crosses and obtaining desirable segregants. A number of methods are currently available for analysis of genetic diversity in germplasm accessions, breeding lines and populations. Principal component analysis is one of them. It was invented by Karl Pearson in 1901. It is a simple non parametric method for extracting relevant information from confusing data sets. With minimal efforts PCA provides a roadmap for how to reduce a

complex data set to a lower dimension to sometimes hidden, simplified structures that often underlies it. Principal component analysis is appropriate for obtaining measures on a number of observed variables and to developing a smaller number of artificial variables (called principal component) that will account for most of the variance in the observed variables. The principal component may then be used as predictor or criterion variables in subsequent analysis.

Material and Methods

A field experiment was conducted with standard agronomical package of practices at IGKV, RMD CARS, Research and Instructional Farm, Ajirma, Ambikapur (C.G.) during Kharif 2016 which is located at a latitude of $20^0$8'N, longitude of $83^0$15'E and altitude of 592.62 m MSL (mean sea level). A field trial was conducted using 191 germplasms (95 inbreds & population received from WNC, Hyderabad; 82 inbred lines developed at RMD CARS Ambikapur and 14 local germplasm) and five checks. These varieties were sown during *Kharif*, 2016 in a Randomized Block Design replicated twice. Each variety was sown in double rows of 4 m row length adopting a spacing of 75 cm between rows and 20 cm between the plants. All the recommended agronomic package of practices was adopted during the entire crop growth period. In each replication, five plants were taken at random and the following 14 biometrical observations *viz*., days to 50% tasselling, days to 50% silking, days to 80% brown husk maturity, plant height (cm), plant population per plot, ear height (cm), ear length (cm), ear girth (cm), no. of kernel rows per cob, no. of kernels per row, no. of cobs per plot, test weight (gm), shelling percentage, grain yield kg/plot were recorded.

Result and Discussion

In present investigation PCA was performed for yield and yield contributing traits of maize and presented in table-1. Out of fourteen, only four principal components (PCs) exhibited more than 1.0 Eigen value, and showed about 76.11% variability among the traits studied. So, these four principal components were given due importance for the further explanation. The PC1 had 33.42%, PC2 showed 19.05%, PC3 exhibited 16.49% and PC4 showed 7.15% variability for traits under study. From four PC values PC1, PC2 and PC3 contributed for yield attributing traits. However PC4 poorly contributed for yield in comparison with above PCs, so for selection of lines for yield improvement PC1, PC2 and PC3 is useful, but PC2 would be the best. PC1 was related to days to 80% maturity, final plant stand, plant height, ear height, ear length, ear girth, number of cobs per plot, number of kernels per row, test weight and grain yield kg per plot, PC 2 was related to number of kernels per row and shelling percentage, PC 3 was related to days to 50% tasseling, days to 50% silking and ear length, while, PC 4 was related to plant height and ear height. These findingsare in agreement with the findings of Ashfaq *et al.*, (2012) [1] in rice, Sajjad *et al.*, (2011) [5] for yield related traits in wheat, Okporie, E. O. (2008) [4] for yield related traits in maize, Leilah and Al-Khateeb (2005) [3] in wheat for spike diameter was obtained.

In 196 maize genotypes, top ten principal component scores (PC score) were estimated in these four components and presented in table-2 & 3. These scores can be utilized to propose precise selection indices whose intensity can be decided by variability explained by each of principal component. High PC score for a particular genotype in a particular component denotes high values for the variables in that particular genotype. PC scores from table-.2 revealed that genotype TNAU/CBE-98, CAL 14114, IAMI-73, CAL 1462, CAL 14111 and Z490-23 in PC1 indicated that they had highly and positively associated for the characters contributed for yield traits viz., days to 80% maturity, final plant stand, plant height, ear height, ear length, ear girth, number of cobs per plot, number of kernels per row, test weight and grain yield kg per plot. The highest PC score of IAMI-44 followed by BLD 7, PFSR R5, Pharas gaon I-4, Jagdalpur I-2, IAMI-7, SC-104, IAMI-33, PC-106 and Pharas gaon I-I in PC2 exhibited for characters number of kernels per row and shelling percentage. Highest PC scores was obtained by IAMI-40, IAMI-29, IAMI-17, CML289-B-B-B, IAMI-22, IAMI-55, IAMI-35, VL121230, TNAU/CBE-98 and Pharas gaon I-I for characters like, days to 50% tasseling, days to 50% silking and ear length. PC scores in PC4 were recorded highest for characters plant height and ear height in genotypes DMR 10 RYFWS 8384 (B), SC-24-9(C12)-3-2-1-1, CM 104, IAMI-87, Jagdalpur I-2, IAMI-74, IAHM 2015-45, EC-611064, Z489-92 and Pharas gaon II-I. Among these the genotypes CAL 14114, IAMI-73, CAL 1462, Z490-23, TNAU/CBE-98, IAMI-44, BLD 7, PFSR R5, Jagdalpur I-2, IAMI-7, IAMI-33, PC-106(2011), IAMI-40, IAMI-29, IAMI-17, IAMI-22, IAMI-55, IAMI-35, VL121230, EC-611064, Z489-92, were identified as diverse lines.

Scree plot (Fig.-1) has been laid out between Eigen value and principal component and showed% of total variation between them. First principal component showed highest variation 33.42% followed by 19.05% (second PC), 16.49%% (third PC) and 7.15% (fourth PC). Total variation of four PCs was recorded 76.11%. Semi curve line obtained after fourth PC with little variation observed in each PC indicated that maximum variation was found in first PC; therefore selection from this PC may be desirable. From first four PCs it was cleared that all traits can be given high weightage value. Hence a good breeding programme can be initiated by using the characters.

From the above study diverse lines identified are CAL 14114, IAMI-73, CAL 1462, CAL 14111, Z490-23, TNAU/CBE-98, IAMI-44, BLD 7, PFSR R5, Pharas gaon I-4, Jagdalpur I-2, IAMI-7, SC-104, IAMI-33, PC-106, Pharas gaon I-I, IAMI-40, IAMI-29, IAMI-17, CML289-B-B-B, IAMI-22, IAMI-55, IAMI-35, VL121230, EC-611064 and Z489-92. They can be utilized for further breeding programme.

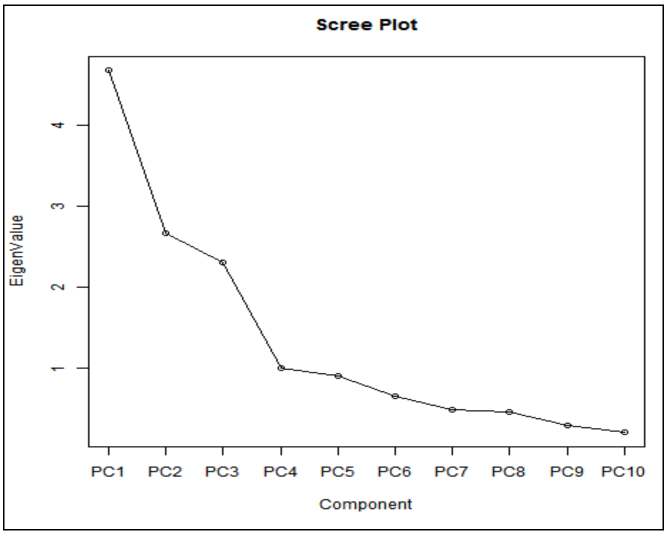

Fig 1: Scree plot diagram

Table 1: Principal Components, Eigen value, Standard deviation, Proportion of variance and Cumulative frequency for 14 yield contributing traits of maize

Traits	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10	PC11	PC12	PC13	PC14
X1	0.0006	-0.5286	0.2489	-0.1025	-0.0046	-0.2937	0.0766	-0.2146	-0.0941	0.0406	-0.0287	-0.1210	0.6934	0.0562
X2	-0.0228	-0.5252	0.2636	-0.0836	-0.0132	-0.2915	0.0522	-0.2042	-0.0109	0.0353	-0.0858	-0.0423	-0.7087	-0.0700
X3	0.2190	-0.3391	0.1994	0.0909	0.0584	0.0880	-0.4776	0.7376	0.0036	-0.0023	0.0237	0.0690	0.0151	0.0050
X4	0.2047	-0.2410	-0.5070	-0.0486	-0.1037	-0.0260	0.0546	0.0244	0.3452	0.0038	-0.1160	-0.0109	0.0772	-0.6978
X5	0.3372	0.1327	0.0720	0.4399	-0.2659	-0.1623	-0.2247	-0.1871	-0.715	-0.5491	-0.3627	-0.2211	0.0039	0.0175
X6	0.3434	0.1441	0.1322	0.3093	-0.2990	-0.2094	-0.2229	-0.2407	0.1347	0.5698	0.2806	0.2918	0.0164	-0.198
X7	0.3545	0.0290	0.2386	0.0824	0.1254	-0.1163	0.5562	0.1594	0.1986	-0.3975	0.4378	0.2361	-0.0002	-0.0308
X8	0.3820	-0.0134	0.1560	-0.2473	0.0388	0.3382	0.1595	-0.1017	-0.1855	0.0847	-0.5522	0.5190	0.0283	0.0067
X9	0.2139	-0.2477	-0.4968	-0.0530	-0.0852	-0.0438	0.0556	0.0050	0.3487	-0.0012	-0.0620	0.0314	-0.0493	0.7086
X10	0.1899	0.0745	0.1334	-0.6155	-0.6251	0.1748	-0.0876	0.0039	-0.0260	-0.1214	0.2480	-0.2348	-0.0287	0.0014
X11	0.3599	0.2370	0.0744	-0.0609	0.1488	-0.2181	0.3222	0.2757	-0.0434	0.4062	-0.2495	-0.5696	-0.0381	0.0218
X12	0.3062	-0.1412	0.0985	0.0625	0.4269	0.5584	-0.1829	-0.3840	0.1550	0.0193	0.2282	-0.3473	-0.0239	-0.0076
X13	0.1822	0.2606	-0.0663	-0.4711	0.4516	-0.4782	-0.4193	-0.1229	0.0607	-0.1603	0.0340	0.1347	0.0056	-0.0199
X14	0.2608	-0.1462	-0.4284	0.0606	0.0445	-0.0420	0.0382	-0.0157	-0.7892	-0.0039	0.3002	0.0129	-0.0663	-0.0164
Eigen value	4.6781	2.6677	2.3083	1.0008	0.8962	0.6446	0.4844	0.4581	0.2830	0.2029	0.1893	0.1424	0.0340	0.0103
Standard deviation	2.1629	1.6333	1.5193	1.0004	0.9467	0.8029	0.6960	0.6769	0.5320	0.4504	0.4350	0.3773	0.1843	0.1015
Proportion of variance	0.3342	0.1905	0.1649	0.0715	0.0640	0.0461	0.0346	0.0327	0.0202	0.0145	0.0135	0.0102	0.0024	0.0007
Cumulative proportion	0.3342	0.5247	0.6896	0.7611	0.8251	0.8711	0.9057	0.9385	0.9587	0.9731	0.9867	0.9968	0.9993	1.0000

X1- Days to 50% tasseling, X2- Days to 50% silking, X3- Days to 80% maturity, X4- Final plant stand, X5- Plant height (cm), X6- Ear height (cm), X7- Ear length (cm), X8- Ear girth (cm), X9- Number of cobs per plot, X10- Number of kernel rows per cob, X11- Number of kernels per row, X12- Test weight (100gm), X13- Shelling percentage (%), X14- Grain yield (kg/plot).

Table 2: List of selected genotypes in each principal component

PC1	PC2	PC3	PC4
NK 30	IAMI-44	IAMI-40	DMR 10 RYFWS 8384 (B)
IAHM 2015-45	BLD 7	IAMI-29	SC-24-9(C12)-3-2-1-1
Hishell	PFSR R5	IAMI-17	CM 104
TNAU/CBE-98	Pharas gaon I-4	CML289-B-B-B	IAMI-87
JK 502	Jagdalpur I-2	IAMI-22	Jagdalpur I-2
CAL 14114	IAMI-7	IAMI-55	IAMI-74
IAMI-73	SC-104(2011)	IAMI-35	IAHM2015-45
CAL 1462	IAMI-33	VL121230	EC-611064
CAL 14111	PC-106(2011)	TNAU/CBE-98	Z489-92
Z490-23	Pharas gaon I-I	Pharas gaon I-I	Pharas gaon II-I

Table 3: Principal component scores of maize genotypes

Genotype	PC1	PC2	PC3	PC4	PC5	PC6
Baderajpur I-3	2.7251	1.1609	0.6201	0.9979	-0.1691	0.2261
Bijapur II-1	-0.9442	2.0575	1.1445	-0.4031	0.2698	-0.9353
BLD 7	-1.0433	3.0810	0.3057	1.0244	-0.4012	-0.3150
BML 14	1.4477	-1.4134	-1.7726	0.0145	0.5477	-0.4978
BML 15	-0.0794	-3.1957	2.2749	0.9517	0.2915	-1.6776
BML 6	0.7117	-0.2560	-1.3968	-2.3045	0.6362	0.6199
BML 8	2.4289	-0.1606	-1.5120	-0.2782	-0.5095	-0.2316
CAL 14100	-0.3814	-2.1361	-1.5288	-1.8892	-0.3448	-0.1912
CAL 14111	3.6586	-3.2299	0.3930	0.8397	-0.8853	0.6010
CAL 1425	-1.4398	-1.5783	-2.3490	-0.1498	1.3415	-1.0207
CAL 1429 (VL 1043)	0.8170	-5.3160	-0.2112	1.3809	-0.8495	0.5155
CAL 1441	-0.4959	0.3784	1.2166	0.5175	1.4713	-1.0557
CAL 1454	2.4327	0.6875	-1.6499	0.7810	-0.7448	-1.7402
CAL 1462	4.0279	-0.7858	-0.9492	0.0296	0.6553	1.3682
CAL 1468	-0.5433	-0.4212	-2.8302	0.0047	0.7785	-0.3526
CAL 1480	1.5941	-0.6510	-1.4343	-0.1342	0.9884	0.3394
CAL14114	4.6814	-1.1190	0.2099	0.2849	0.5044	0.6254
Chhind gaon II-3	-2.7752	1.0336	0.1445	-0.1814	0.9669	0.5760
CIL 1218	-1.8444	0.4002	-0.5658	0.2988	0.7778	-0.5031
CM-123	1.8319	-0.9541	-1.5970	-0.1568	-0.1048	-0.1516
CM-209	-1.1331	0.7580	-0.6999	0.4004	0.7524	-0.5810
CM 104	-3.9202	-1.1662	-0.4453	2.3189	-0.3593	0.1926
CM 105	-2.2485	0.6822	0.7597	-1.5519	-0.9434	-1.0203
CM 212	1.0483	-1.7926	0.4079	1.5953	-1.0894	1.1656
CM 501	2.4898	0.2132	-1.3188	-0.3261	-0.3450	0.9330
CML-175	0.1731	1.7721	0.0058	-0.9065	-0.0391	0.2138
CML 161	1.8635	-0.6305	1.6315	0.0381	0.7050	-0.2044

CML 162	0.5513	0.2357	0.5042	-0.0220	-0.7477	-1.0555
CML 425	0.9543	-0.2191	-2.4756	0.5197	0.9669	0.5648
CML 451 (P2)	-3.4587	-2.9967	1.9489	-0.0701	0.4164	0.2645
CML 70	1.7226	-0.6958	1.3591	0.0071	1.0241	-0.3189
CML165-B-B-B	-1.6469	0.9799	0.6187	-1.2545	-1.0650	-0.7495
CML289-B-B-B	0.0494	-2.3446	2.6670	-0.9754	-1.2066	-1.1917
Dantewada II-1	2.5890	1.4487	1.9263	-2.0987	1.1658	1.7792
DMHOC-15	-2.1456	1.5132	0.6465	-1.3150	-0.0012	-0.3780
DMR 10 RYFWS 8105 (A)	-1.8972	-1.5720	1.5268	-0.4279	-0.4292	0.4008
DMR 10 RYFWS 8279 (B)	0.4171	-3.0382	0.7789	1.0973	-0.7710	0.3717
DMR 10 RYFWS 8384 (B)	-1.3129	-3.0678	0.7987	3.3738	1.6696	1.1358
DMR 11 R 0144	-3.2406	-0.1369	-0.3903	0.3776	-0.5952	-0.9025
DMR 11 R 4785	-3.9052	-0.1274	0.4408	-1.0729	0.0718	-0.9524
DMR 19 RYDWS 1247	-3.5416	1.0599	-0.3203	0.2514	0.9349	0.1540
DMR T4	-2.7782	1.3436	-0.4288	-0.7533	-0.8023	-0.3883
DMRQPM 03 -104	-1.2236	1.1726	0.7825	-0.1846	0.9594	0.9039
DMRSCY 18 R 715	-2.9080	0.9167	0.3470	-0.7016	0.8339	-0.6915
DMSC 20	-0.7278	2.2202	-0.0247	0.1263	-1.2434	-0.5709
DMSC 6	-1.3583	-0.1034	-2.0538	1.4020	-2.6477	0.2448
EC-611064	-1.8618	-1.7405	-2.0967	1.8235	-0.7661	0.2872
EC440631	-0.2854	-2.8082	-0.7808	-1.1386	-0.7197	0.3045
G33 QC20-B-B-B-1-B-B-B	0.6866	1.0381	1.5932	1.0954	0.3274	-0.2183
Hishell	6.5289	-0.1431	-1.7420	0.8665	1.4270	-0.0958
HK-193	-0.4545	-3.1844	-0.8426	-1.5420	1.1486	-0.1923
HKI-1126	-2.1552	0.8170	0.5522	0.0892	-0.4994	0.0527
HKI-1324-1	2.4404	1.0922	-1.4748	1.0052	-0.5600	-0.4545
HKI-1342	-2.4272	0.4483	0.1606	0.0328	-1.7020	2.1631
HKI SCT	-0.1337	0.9575	0.7273	0.6787	-0.5370	-0.1452
IAHM2015-45	6.8798	0.1849	-1.7258	1.9669	1.5009	-0.2936
IAMI- 04	-1.9802	-0.0320	-0.1571	0.3196	0.0519	-0.0562
IAMI- 06	-0.2645	0.9641	0.5287	0.5098	0.4921	-1.6681
IAMI- 08	3.3471	1.2301	-1.1809	-0.3381	-1.1854	-1.2219
IAMI- 10	-0.1169	0.5937	0.8212	0.4264	-0.0638	1.0233
IAMI- 12	1.7372	0.5482	0.7794	0.5623	-2.0704	-1.1869
IAMI- 13	1.7039	0.8138	0.5126	-0.7040	-1.1504	-0.4569
IAMI- 14	-1.4691	-0.2740	0.3780	-0.5376	-0.2772	-1.6138
IAMI- 15	-2.4623	0.2034	0.7197	0.7375	-0.0667	-0.9601
IAMI- 16	-0.6449	1.9609	0.2059	0.3722	0.2907	-0.5256
IAMI- 19	-2.6559	-0.7996	-3.5082	1.0677	-1.0637	1.3910
IAMI- 20	1.0353	0.8470	0.4056	-0.7988	-1.1279	0.4506
IAMI- 21	-1.4124	0.2378	0.6282	-0.4076	0.3013	0.8648
IAMI- 22	-0.9667	-1.0125	2.6034	0.6535	-0.7676	-0.3634
IAMI- 23	-1.3886	1.5116	0.0910	-0.2888	0.7680	0.5771
IAMI- 25	-1.2144	-0.3616	0.7688	-0.9884	-0.4895	0.8225
IAMI- 27	-1.1272	-2.7602	-2.1182	0.3721	-0.3623	-1.4448
IAMI- 28	-0.8982	-0.5672	0.3843	0.8330	-1.3565	1.9931
IAMI- 30	-1.1180	0.4175	0.8726	0.6893	0.0231	-0.0256
IAMI- 31	2.0230	-1.3322	-1.3345	-1.7463	-0.9983	-0.5628
IAMI- 32	0.2042	-1.5400	1.4316	0.3007	-0.4417	-1.4968
IAMI- 38	-1.3819	1.5051	1.7047	1.0492	-1.8139	-0.1596
IAMI- 39	1.9259	0.0519	-1.5191	-0.0982	-2.3252	0.1762
IAMI- 40	0.4802	-3.0517	3.4018	-0.1361	-0.6824	-0.7073
IAMI- 41	-1.6396	1.1142	0.6303	-0.4193	1.0352	0.9696
IAMI- 42	0.4728	-1.2066	-1.5849	0.1675	-0.4357	-0.4029
IAMI- 43	-0.9708	0.7581	-0.4388	0.3194	0.6409	0.1091
IAMI- 44	0.9439	3.1548	0.6818	0.4592	-0.5816	0.1323
IAMI- 45	-2.6835	0.3161	-0.6323	1.2011	0.4975	0.8723
IAMI- 46	-0.6327	1.7741	1.0625	-0.7552	1.0304	0.1014
IAMI- 47	2.0771	-1.8463	-1.1161	0.1134	0.9280	-1.0201
IAMI- 48	1.1608	0.7055	0.8239	0.8894	-0.4721	0.0394
IAMI- 49	-0.9231	-2.6238	-1.5439	0.2054	1.1553	-1.7483
IAMI- 50	-1.0622	-3.3578	1.5722	-1.2079	-0.0154	-0.0711
IAMI- 51	-1.1007	0.4195	-2.7756	-1.6683	0.4692	0.5872
IAMI- 52	-2.2950	1.2839	0.1561	-0.6474	0.2519	-0.5558
IAMI- 53	-1.6144	1.0472	0.7592	-0.0063	-0.6217	-0.3025
IAMI- 54	-0.7015	-1.1986	-1.7686	-0.7442	-0.5124	-0.1032
IAMI- 55	1.7175	1.3124	2.5745	-0.9428	0.8954	0.3132
IAMI- 56	1.0099	2.0605	0.9451	-0.8056	0.1550	-0.0617

IAMI- 57	-0.4086	0.6193	0.1950	-0.0952	0.7969	0.1671
IAMI- 58	1.9369	2.1328	1.3025	-0.4526	-0.4797	0.2846
IAMI- 59	0.1891	0.5096	0.1924	-0.8765	0.2319	0.0150
IAMI- 60	0.2928	0.3959	-2.0434	-0.0370	0.8458	-0.3928
IAMI- 61	0.1264	1.6524	0.3987	0.2783	-0.4386	-1.4578
IAMI- 62	-0.7298	0.7169	-1.6046	0.5511	1.5140	-0.1056
IAMI- 64	-0.2603	1.7895	0.4149	-0.0687	-0.6182	-0.0232
IAMI- 65	-2.1905	1.0448	-0.3975	1.0950	-0.0542	0.2328
IAMI- 66	0.0449	-0.2154	-2.6969	-1.5029	0.3242	0.7822
IAMI- 67	-1.0079	1.5079	1.0552	0.6170	1.3134	-0.6619
IAMI- 68	1.2991	-0.1929	-0.4104	-1.6899	-0.4965	-0.0599
IAMI- 69	-0.9388	-0.0417	-3.3479	1.0000	-0.9849	-0.4508
IAMI- 71	3.2467	1.7903	2.1897	0.0348	0.4618	0.6243
IAMI- 73	4.3077	0.0735	-0.3800	0.2498	-0.6964	-0.0939
IAMI- 74	-5.8489	-0.1732	-1.3122	1.9864	0.6804	0.6970
IAMI- 81	-1.8675	1.8689	-0.5263	1.1528	-1.7434	-0.0790
IAMI- 82	-2.0827	1.7560	-3.9397	0.0930	-0.7597	0.9458
IAMI- 83	3.2526	1.1566	2.4034	0.4101	1.2943	0.5903
IAMI- 84	0.8291	0.2494	1.6044	0.0428	-0.6871	0.0796
IAMI- 87	-1.8231	-2.6450	-0.5913	2.1054	0.5643	1.1147
IAMI-02	0.8060	-2.7959	-0.8404	-2.1008	-0.7976	-0.1185
IAMI-1	1.4979	1.5560	0.7793	-0.1355	-0.5277	0.5932
IAMI-11	1.8541	-1.6779	-0.2579	-0.7472	0.2008	0.1612
IAMI-17	1.1918	-2.6237	2.8696	0.7884	0.9672	-0.0350
IAMI-18	3.4528	-1.4410	-0.3612	-0.6014	-0.4423	-1.1259
IAMI-29	-0.1893	-3.0369	2.9666	-0.2151	-0.5075	-0.6952
IAMI-3	-0.5886	0.8664	0.4280	-0.0411	0.6717	0.4240
IAMI-33	0.8944	2.3944	-3.1148	-0.8767	-1.0380	-0.3832
IAMI-34	-0.1683	-2.3485	-1.2440	-1.9921	0.6192	0.4916
IAMI-35	0.4715	-2.9087	2.5302	0.0657	-2.6932	1.0221
IAMI-36	1.6981	-2.4843	-0.6106	-1.0933	0.6643	1.4413
IAMI-37	1.0018	1.0476	0.3770	0.2620	0.4155	0.5734
IAMI-5	-1.1665	-0.2197	-2.5898	-1.6407	-0.4563	0.7279
IAMI-7	-0.4721	2.4736	1.0656	-1.1905	-0.8522	0.1685
IAMI-85	0.3471	-2.8492	-0.0140	-1.9714	-0.7873	1.3539
IAMI-88	0.8388	-2.8276	-0.1698	-0.0948	-1.1691	-0.8894
IAMI-89	1.1359	-3.4402	1.6221	-0.6729	-0.6167	-0.2140
IAMI-9	0.0052	-0.8362	-2.6186	-1.9343	0.5950	0.5563
Jagdalpur I-2	0.4115	2.5679	1.2178	2.0765	0.6228	0.8069
JK 502	6.4465	0.2144	-2.1478	-0.0564	-0.6943	0.0970
Kate kalyan II-2	-2.1697	1.0675	-1.0445	0.0043	0.2228	-0.6346
Keshkal I-6	-0.5356	1.3931	-0.3245	0.0318	0.7767	0.8328
Keshkal I-8	1.7058	1.1774	1.8248	0.5855	0.8307	-0.0050
Kondagaon I-4	-0.1005	1.6862	-0.5247	1.1460	0.2287	-0.5739
MRC PC 13	-2.7969	-1.4142	0.8812	1.6362	-0.2189	0.2245
MRC PC 22	-2.9672	0.8172	-0.1799	-1.3422	-0.2911	1.2725
MRC PC 29	-0.2671	-0.0921	1.1554	0.2616	-2.1082	1.2770
MRC PC 6	0.5109	0.3273	-2.4747	1.5396	-1.8870	-0.2880
MRC PC 8	-1.5302	1.8462	0.1566	0.0227	-0.8426	1.9435
MRC SC 8	-2.3044	0.6790	1.1746	-0.3263	-1.7805	-1.1645
NK 30	8.6902	-0.2359	-2.8661	1.4963	0.8688	0.2168
P-62-C6-B-B-B-31-B-B-B	1.3537	-1.9377	-1.0932	0.3852	-1.3627	0.2863
P67-C1-B-B-B-37-B-B-B	-1.0732	-2.0342	1.7327	0.5593	-0.8785	-0.7324
PC-106(2011)	-1.1156	2.2643	0.7829	0.5816	-0.5413	-0.4511
PFSR R3	0.9736	1.8585	0.2463	1.4716	-0.1433	-1.0495
PFSR R5	1.4807	3.0490	1.1002	-1.0384	-2.0563	0.2779
Pharas gaon I-1	-0.7604	2.2211	-0.4188	0.7461	0.9996	0.9521
Pharas gaon I-4	-0.6687	2.6159	-0.7764	0.5442	0.8039	0.2521
Pharasgaon II-1	-0.6893	1.7867	-0.6037	1.6966	0.8505	-1.3245
Pharasgaon II-2	0.0248	0.5488	-2.4763	-0.3349	-0.4185	-0.3858
Pro 4212	2.6069	2.0729	-2.4535	-0.5459	0.6143	-0.2652
S87(P56Q)-B-B-B-17-B-B-B	-2.0976	-0.7915	1.4009	-0.1170	0.0027	-1.1824
S87(P66Q)-B-B-B-30-B-B-B	0.8628	1.0612	1.3948	0.9519	-0.0717	-0.5447
SC-104(2011)	-1.6511	2.4582	0.3772	-0.5923	0.7825	0.7584
SC-109(2011)	-0.3279	-0.8275	-2.0081	-1.0759	-0.6330	0.2029
SC-24-9(C12)-3-2-1-1	-3.1685	-1.2801	0.4188	2.5356	-0.9774	2.3618
SC 7-2-1-2-1-6-1(N)	3.1760	1.9130	2.2018	0.3928	-0.8539	-0.1910
SC7-2-1-2-6-1	-2.3669	1.5009	0.4244	-0.0813	0.2006	1.3507

SNL 142798	1.3776	1.8349	0.2892	0.5289	0.2489	0.1863
SNL 142851	-2.8281	0.9000	-0.0923	-1.2422	-0.5957	0.1065
SO1SIWQ-2-B-B-B-38-B-B-B	1.1110	-0.3625	1.9618	-0.4747	0.2695	-0.3956
SOOTLYQ-HG-35-B-B-B	-1.5420	-1.1536	0.5747	0.7082	-0.1492	-0.3446
TNAU/CBE-98	6.4865	1.4676	2.4172	1.1367	-0.4276	-0.1919
V941-20	-0.4006	-2.0308	-1.9917	-0.1467	0.7513	-0.7176
V941-25	-2.8992	1.0410	0.5695	-0.9413	0.8151	-0.7362
VL 121160	1.7635	-3.1477	-0.5371	0.1874	-0.1077	0.8221
VL121230	0.2572	-2.0331	2.4703	-1.2128	1.0274	-0.7032
Z-15-1	2.7726	0.7772	-1.0070	-0.8575	0.6752	0.7873
Z-49-45-CA-14514-2-1-2-B-B	-0.6219	-0.5833	-1.7483	-0.0093	0.7118	-1.3423
Z-51-20	-1.7017	0.5320	-4.2059	1.4105	0.9899	-0.6841
Z-56-2-TL-SEOULA503446-B-B-B-1-B-B-B	1.6423	2.1360	1.4118	-0.9925	-1.2847	-0.0198
Z 484-32	-0.3695	1.3714	0.5505	0.4995	1.0083	-0.0477
Z 485-4	1.8037	0.9254	0.9207	-0.7100	1.8634	0.8440
Z 486-7	-1.4253	0.0127	0.6712	-0.8651	1.5520	-1.0730
Z 487-4	-0.8551	1.1932	-3.4706	-0.6861	0.0943	0.0694
Z 491-3	-2.7561	0.5831	0.1698	-0.4155	0.6932	-0.2738
Z485-17	2.6267	1.5891	1.9417	-0.4319	0.7035	-0.1714
Z486-3	-2.1880	-0.8566	1.2760	-0.3896	1.6163	0.1961
Z489-107	-0.1279	-2.5807	1.7779	0.4023	2.2388	0.6533
Z489-134	1.5714	-1.3551	2.3203	0.7196	2.7398	0.8103
Z489-144	-3.5500	-1.2965	-0.3848	-1.1758	1.7186	-0.3092
Z489-69	0.1786	0.1103	-2.0151	-0.9350	0.8158	0.7822
Z489-92	-2.8109	-1.5102	0.9106	1.8114	0.3728	1.1026
Z490-23	3.6005	0.4301	1.7295	0.2587	0.5187	0.3703
Z490-24	-1.9165	-0.8478	1.8331	-2.0410	0.4430	1.3155
Z491-17	-0.6243	-0.8724	1.1539	-1.4283	0.3841	-0.5134
Z491-28	2.2724	1.0816	2.0801	-1.6799	-0.7601	0.8840
Z491-35	-0.3723	-0.2455	1.4260	0.6608	0.5714	-1.1112
Z491-50	-0.6591	-0.0025	-1.0659	0.0929	0.9838	-1.5106

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